Arctic Heritage

Proceedings of a Symposium

Editors
J.G. Nelson
Roger Needham
Linda Norton

Association of Canadian Universities for Northern Studies

Arctic Heritage
Proceedings of a Symposium
August 24-28, 1985
Banff, Alberta, Canada

J.G. Nelson
Roger Needham
Linda Norton
(Editors)

Symposium Sponsors

Association of Canadian Universities for Northern Studies (ACUNS)

Commission on Ecology (COE)

Commission on National Parks and Protected Areas (CNPPA)

International Union for Conservation of Nature and Natural Resources

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Preface

Arctic Heritage and ACUNS

Marc-Adélard Tremblay, President, ACUNS

The Association of Canadian Universities for Northern Studies (ACUNS) sponsors and organizes a considerable number of conferences. It was particularly pleased, indeed proud, to sponsor the Arctic Heritage Symposium, upon which this volume is based, because it represented the culmination of a number of objectives which the Association has had for many years.

Many readers of this volume will not be aware of ACUNS and its activities. We are an association of 35 Canadian universities, brought together by a common interest in the polar regions and "Northern Studies." Our official purpose is the advancement of northern scholarship through education, professional and scientific training, and research.

We fulfill this mandate by maintaining an office in Ottawa (#1915, 130 Albert Street, Ottawa, Canada KIP 5G4, (613) 238-3525) which acts as the centre of an information network linking our member universities, governments, native associations and private industry. We issue a newsletter, *Northline/Point Nord* in French and English, four times each year and a series of publications on topics such as social science in the North, distance education in the North, the use of Greenlandic and Danish in Greenland schools, ethical principles for the conduct of research in the North, and Canada's northern stations. One of our more important publications is the *List of Northern Specialists*, a directory to polar scholars in universities across Canada.

We also fulfill our mandate through an extensive scholarly support program, The Northern Studies Trust which administers studentships to outstanding students; provides special awards for native students and northern residents and fellowships for established practising scholars.

Another of our important activities has already been mentioned, the organization of conferences on selected themes. We have held meetings devoted to such topics as renewable resources and the economy of the North, resources dynamics of the boreal zone, northern health issues and northern engineering. Our most recent conference was a meeting of four of Canada's "subarctic" universities. This was arranged so that they could share experiences to their mutual benefit and to the benefit of others involved in higher education in remote regions in Canada and abroad.

Our 1985 Arctic Heritage Symposium was a particularly fine example of the sort of meetings we aspire to develop. It was devoted to an extremely topical and "useful" theme, Heritage. It was truly international, involving 12 countries and the co-sponsorship of two Commissions of the

International Union for the Conservation of Nature and Natural Resources (IUCN). In this sense it was especially rewarding since ACUNS has, for a number of years, been striving to improve links between universities and research organizations in Canada and abroad especially in the circumpolar countries.

The conference theme was interdisciplinary with both "academic" and "applied" aspects. As an Association we view "Northern Studies" as truly interdisciplinary. In our view, scholars in the North today simply cannot be effective if they retain a strongly disciplinary mindset. A geophysicist, for example, must be aware of the environmental, political and social realities of the North. Also, although we are at base an "academic" organization, we recognize that "Northern Studies" inevitably has "applied" overtones. Our universities have a special responsibility for that part of the globe, "the North," which they study. In this sense the Arctic Heritage Symposium was of strategic importance in suggesting ways and means of using and saving our Arctic Heritage from the biological, cultural and overall environmental points of view.

Thus "Arctic Heritage" is very special to ACUNS. And the Arctic Heritage Symposium was a very special occasion for us. On behalf of myself, our Board and Council and member universities, I gratefully acknowledge the work of Professor Gordon Nelson and his Coordinator, Professor Roger Needham in bringing the Symposium to fruition. Readers will detect, from the organization of this volume, the careful structuring which made the Symposium such a great success. It was a fine example of *creative* use of a symposium format.

This book is a lasting testimony to the fine work of Professors Nelson and Needham.

Le patrimoine arctique et l'AUCEN

Marc-Adélard Tremblay

L'Association Universitaire Canadienne d'Etudes Nordiques (AUCEN) parraine et organise de nombreuses rencontres. Nous avons été heureux, voire même fiers, de parrainer le symposium "Patrimoine arctique", sur lequel se base ce livre car il symbolise les orientations de l'association ces dernières années.

Parmi les lecteurs de ce livre plusieurs ne connaissent sans doute pas l'ACUEN et ses activités. C'est une association de 35 universités canadiennes qu'un intérêt commun dans les régions polaires et les études nordiques a regroupées. L'objectif officiel est de promouvoir les études sur les régions nordiques, par le biais de l'éducation, la formation professionnelle et la recherche.

Nous remplissons ce mandat grâce à un bureau à Ottawa, (au 1915, 130 rue Albert, Ottawa, Canada KIP 5G4 – 613-238-3525) qui est la pièce maîtresse d'un réseau d'information reliant les universités membres, les gouvernements, les associations locales et le secteur privé. Nous publions trimestriellement un bulletin, Northline/Point Nord, en français et en anglais, ainsi qu'une série de publications sur des sujets tels que les sciences sociales dans le Nord, le télé-enseignement dans le Nord et l'utilisation des langues groënlandaise et danoise dans les écoles du Groënland, l'éthique et la recherche dans le Nord, et les stations du Nord-CANADA.

Notre répertoire des spécialistes dans le domaine est l'une de nos publications les plus prisées et intéresse les chercheurs spécialistes en régions polaires partout au Canada.

Ce mandat, nous l'exécutons aussi en parrainant un important programme d'éducation, le "Fonds pour les études sur le Nord" qui offre des bourses aux meilleurs étudiants, des allocations d'étude aux autochtones et aux résidents du Nord et un support financier à des chercheurs confirmés. Nous avons déjà fait état d'une autre activité importante, c'est-à-dire l'organisation de rencontres sur des thèmes d'intérêt particulier. Nous avons tenu des réunions axées sur des sujets tels que les ressources renouvelables et l'économie du Nord, la dynamique des ressources de la zone boréale, les problèmes de santé et l'ingénierie en régions nordiques. Notre tout dernier symposium a réuni quatre des universités "subarctiques" canadiennes. Ceci, pour mettre en commun leurs expériences pour leur propre profit et celui des autres impliqués dans l'enseignement supérieur dans les régions limitrophes au Canada et à l'étranger.

Notre symposium de 1985, "Patrimoine arctique" est un exemple frappant du type de réunions que nous souhaitons développer. Il a porté sur un thème particulièrement utile et approprié: le patrimoine. La participation de douze pays et le co-parrainage de deux commissions de l'Union Internationale pour la Conservation de la Nature et des Ressources Naturelles lui ont donné un caractère vraiment international. Dans ce sens, ceci était particulièrement encourageant puisque l'AUCEN s'efforce depuis de nombreuses années d'améliorer les liens entre les universités et les orgamismes de recherche au Canada et à l'étranger, spécialement dans les pays du cercle polaire.

La réunion s'est dotée d'un caractère interdisciplinaire portant à la fois sur des aspects purement "académiques" et des aspects "appliqués." En tant qu'association nous envisageons les études sur le Nord comme interdisciplinaires par définition. Selon nous, les chercheurs ne peuvent être efficaces s'ils se limitent strictement à leur discipline. Un géophysicien par exemple, se doit d'être au courant des questions d'environnement et de politique ainsi que des réalités sociales du Nord. De plus, bien que nous soyons à priori un organisme "académique" nous sommes conscients que les études sur le Nord ont inévitablement des aspects "appliqués."

Nos universités ont une responsabilité toute particulière vis-à-vis cette partie du globe qu'elles étudient, le Nord. Suivant ce principe, notre symposium sur le patrimoine arctique a été d'une importance capitale en suggérant des voies et des moyens d'utilisation et de sauvegarde du patrimoine arctique tant du point de vue biologique et culturel qu'en ce qui touche l'environnement.

Ainsi, le patrimoine arctique tient-il une place de choix au sein de l'AUCEN et ce symposium fut-il une occasion parfaitement appropriée.

En mon propre nom et au nom de notre direction, de notre conseil et des universités membres, je remercie vivement le Professeur Gordon Nelson et son coordonateur, Roger Needham, de leur travail soutenu et grâce à qui ce symposium a vu le jour.

Le lecteur verra, dans la présentation de ce livre, la soigneuse structuration qui fit de ce symposium un tel succès. Quel exemple de l'utilisation novatrice d'un symposium! Ce livre est un témoignage durable des efforts consentis par les Professeurs Nelson et Needham.

Marc-Adélard Tremblay
President, ACUNS
Professor of Anthropology
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June 1986

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J.G. Nelson for ACUNS

Introduction to the Arctic Heritage Symposium

The roots of this Symposium are part of the history of the Association of Canadian Universities for Northern Studies (ACUNS). ACUNS was founded at Churchill, Manitoba in 1977. Registered as a charitable organization, ACUNS is a voluntary association of Canadian universities which have northern interests.

An underlying premise of ACUNS is that if Canada is to manage the development of its North properly, highly skilled and experienced people must be found and major gaps in knowledge must be filled. In keeping with this recognition:

> The purpose of the Association of Canadian Universities for Northern Studies is the advancement of northern scholarship through education, professional and scientific training, and research.

ACUNS has developed programs and projects to address its purpose steadily over the last nine years. Currently it addresses a significant theme each year at its Annual General Meeting (AGM). Past themes have included social science, health, and engineering in the Canadian North. The Association also has standing committees which coordinate and address member interests in research, field stations, education, and scientific and educational land use. Among its resulting publications are ethical guidelines for northern research and guidelines for meeting research regulations in Northern Canada. Among other activities, ACUNS works closely with the Department of Indian Affairs and Northern Development (DIAND) on its Northern Studies Training Grants Program for students wishing to work in the Canadian North. ACUNS has also established a Northern Studies Trust which awards studentships, special awards for northern residents, and senior fellowships. Last year ACUNS also established a northern Native Studentship Program with funding from the federal Native Economic Development Programme. In 1986 ACUNS held its Annual General Meeting in Yellowknife on the general theme of northern education. In this endeavour ACUNS worked closely with northern agencies and interests.

ACUNS also holds symposia from time to time on topics of major concern. The first two were on *Renewable Resources and the Economy of the North* (Freeman, 1981) and *Resources and the Dynamics of the Boreal Zone* (Wein *et al.*, 1983) respectively.

Two major concerns of the Association during the last several years have been the use and conservation of the natural and cultural heritage of the North and the necessity to make effective contact with universities in other northern or circumpolar countries if fuller research and understanding of the global North is to be achieved. No mechanism currently exists for regular exchange of information on research topics and needs, other than through professional journals and similar sources.

After considerable discussion, ACUNS decided to address these two concerns in a combined fashion by holding an Arctic Heritage Symposium on an international basis. The approach to the Symposium was to be scholarly and scientific, dealing with ecological, planning and management aspects of Arctic Heritage use and conservation. In keeping with the intent of finding a way to build links among circumpolar universities, most of the participants were envisioned as coming from research and higher educational institutions in northern countries. In keeping with the growing ACUNS interest in working with northern residents, industry, government and other concerned groups, some participants with heritage research, education, planning and management interests were also envisioned as coming from these sectors. In keeping with the pilot or experimental nature of the Symposium, the participants were also envisaged as a relatively small group, perhaps seventy-five in all.

Suggestions on approach were sought among various groups and individuals and a tentative program was prepared. This was circulated to people in universities, government, and voluntary organizations, and a number of meetings were held to discuss approach, topics, and possible speakers, discussants, and participants. With the aid of a Department of Environment research contract to obtain ideas for a proposed related federal government conference on international conventions and agreements for conservation in the Arctic, consultations were held in government departments, universities, institutes, and voluntary organizations in Norway, Sweden, Finland, Denmark and Switzerland (International Union for the Conservation of Nature and Natural Resources (IUCN)). Many suggestions were received and on the basis of these consultations and others in Canada and elsewhere, the IUCN Commissions of Ecology (COE) and National Parks and Protected Areas (CNPPA) respectively, agreed to cosponsor the Symposium.

Awareness of and involvement in the September 5-8 Canadian National Park Assembly, held to commemorate the Centenary of the first Canadian national park at Banff in 1885, eventually led to the holding of the Arctic Heritage Symposium in Banff, 24-28 August, 1985. Under the circumstances it was possible to carry findings from the Symposium to the Assembly, and thereby have a potentially greater influence on future Canadian heritage policy.

Originally the hope was to hold the Symposium in the North, either in Yellowknife, Northwest Territories, or Whitehorse, Yukon. However, the costs of such a locale were high and funding proved to be very difficult to find for the Symposium. The reasons for this are not entirely clear. Economic conditions were not good at the time. Also many individuals and organizations had strong opinions on approach, topics, and participants and while these could be accommodated to some degree, they could not be sufficiently in some cases.

The specific purposes of the Symposium are set forth in the welcoming remarks which follow this Preface. Briefly, they stress the international nature of the scientific and scholarly interest: rigorous exchange of ideas; learning from the experience of others; identification of research needs; possible cooperative research, planning and management efforts; publication of Proceedings; development of an Arctic regional strategy; and follow-up on an International Forum for Universities for Northern Studies, comparable to ACUNS in Canada.

That these objectives were generally well met at the Symposium seems apparent from the Major Conclusions, which also are published following this Preface, as well as the many ideas and findings presented in the papers themselves.

From the standpoint of the editors the program was a success beyond our greatest imagining. The papers, critiques, and discussions are rich in information and should be of considerable value to all those interested in the circumpolar north, notably the Arctic, however that may be defined. No initial attempt to define the term was made by us, in part because such an exercise would be arbitrary and probably unacceptable to many persons, as a reading of the papers indeed bears out.

We are the more surprised at the rich response and effort made with respect to the Symposium because in many cases we were unable to provide much assistance to the participants. Their willingness to work and participate on the basis of resources often found by themselves, says something about the strength of interest in Arctic Heritage. In this respect we are especially grateful to those organizations which did provide funding for the Symposium, notably ACUNS itself, the Social Science and Humanities Research Council (SSHRC) and the Northwest Territories government. The Department of Indian Affairs and Northern Development was very supportive through its core funding for ACUNS and the assistance it provided its officers to attend. IUCN assisted in similar ways, including financing of a field excursion by CNPPA and Parks Canada. The University of Waterloo provided much indirect assistance in conference development and in publication of these Proceedings.

Aside from our debt to those who prepared papers, we are also very grateful to the chairmen of sessions: Roger Needham (University of Ottawa), Donat Savoie (DIAND), R. Stevenson (NWT), Jose Furtado

(COE:IUCN), Harold Eidsvik (Parks Canada), and R.C. Scace (Reid Crowther: Calgary), as well as the principal rapporteur, Paul Grigoriew (University of Waterloo). We also recognize the assistance of Alberta government personnel and James Gardner in leading a field trip and arranging related activities in the Banff mountain area during the Symposium. Murray McComb and other people at Parks Canada and other agencies also kindly assisted in securing photographs.

Some original participants, such as Derek Ovington (Australia), Lars Esping (Sweden), Antti Haapanen and Matti Helminen (Finland), and Y. Gaava (USSR) could not attend. Sadly, Henning Meyer (Greenland) died after preparing his excellent paper and before he was able to attend the conference. Others, such as Morten Meldgaard (Greenland) filled the gaps and made other contributions as well.

Several persons, including Meldgaard, Peter Adams, Vernon Thomas and S.D. MacDonald, Marianne Stenbaek, John Marsh, W.A. Gryba, and R.J. Stenmark responded to late invitations to contribute, and did so well, as their papers and critiques show. A number of the foregoing persons responded to the invitation to volunteer Participant Statements. Such Statements were envisioned as relatively brief, about 1000 words, but in some cases grew to be longer documents.

As organizers we are very conscious of the considerable assistance from ACUNS through Marc Tremblay, President; Peter Adams, Executive Director; Eileen van Heyst, Administrative Officer, and Board Members. In his former capacity as Executive Officer, Commission on Ecology, IUCN, Marten Blijeveld was very helpful with conference organization. James Thorsell, Executive Officer, Commission on National Parks and Protected Areas, IUCN, also assisted in several ways. We are grateful for the support of the Banff Centre staff; it has been invaluable in hosting this meeting. Linda Norton of the University of Waterloo deserves special thanks for coordinating the publication of the *Proceedings*. Barry Levely and others at Waterloo also were very helpful with maps, figures and cartography. We are very grateful to David Bartholomew and staff with their assistance with graphics and design, and to Cory Burgener and Marko Dumancic for their assistance in setting up the typesetting and design of the book.

The volume and complexity of the information in these *Proceedings* makes us hesitate to highlight items of unusual importance. However, some observations can be made in terms of the original motives and objectives which we presented in the Opening Remarks for the symposium.

1. The concept of heritage, although somewhat vague, appears to be no more so than environment, economy, or technology and seems to have served well as an idea, or umbrella, under which many scholars, planners, and others could find room to think effectively. The

Symposium recommendation that an Arctic Heritage Forum should be established on a regular basis seems to support this view. However, the Board of ACUNS decided at its October 1985 meeting that such a Heritage Forum was too specialized a project for it to manage. Approaches are being made to IUCN and others to see if there is interest in carrying the Arctic Heritage Forum idea forward.

2. The major conclusion that ACUNS should continue to hold meetings and encourage regular links among circumpolar universities through a Circumpolar Universities Group was accepted in principle by the ACUNS Board at its October meeting. Board members were concerned, however, about costs and resources needs. Also, not as many overseas participants as were originally envisaged actually attended the Arctic Heritage Symposium so there is some question about feasibility.

3. Truly vigorous exchanges of ideas and views did occur at the Symposium, especially with regard to the adequacy of our knowledge, planning and management systems. This statement applies not only in Canada but for the circumpolar area as a whole. Heritage concerns and needs are of interest throughout the region and can bring people together in a research, professional, and social capacity–for greater understanding.

4. Much learning from the experience of others occurred; an example is with regard to Greenland where several different types of heritage management areas and institutions exist, notably at the local level. In Greenland many limits have also been placed on snowmobiles and other forms of modern technology in heritage areas in contrast to the situation in Canada and the US. It is also clear that many different types of parks and other institutions are used in the circumpolar region. Sometimes these types are similar among countries; sometimes they are different. Collectively they are not well understood in terms of permitted uses. Hunting, oil exploration, and other activities often said to be prohibited in national parks and protected areas are sometimes allowed and practised. Why this occurs and what the effects are, is not well understood. The claim that designation of lands as protected areas severely limits economic activities and developments is, however, basically untenable as many activities are permitted or planned, with attempts at appropriate safeguards in regard to conservation and sustainable use.

5. Many research needs were identified, for example in the first session on the Natural Realm, where it was clear that we know too little

about climatic and marine processes in particular, to predict directions of environmental change and their impacts on human use. It was recognized that national parks, territorial parks, zapovedniki, wildlife refuges, biosphere reserves (MAB), and other types of heritage areas are vital in this regard, as gene pools and benchmarks for environmental monitoring. It was also recognized that Canada and the USSR in particular have relatively low percentages of their Arctic regions in heritage areas and should act more positively. The coastal areas are environments that were seen as especially important, inadequately understood, and in need of research and better planning and management. The US Coastal Zone Act and management system was discussed as a possible model for countries such as Canada and Norway. The Inuit Circumpolar Conference (ICC) a Pan-Arctic coordinating group among the Inuit people, has expressed strong interest in coastal issues and in research and environmental management generally. ICC reportedly is preparing an Arctic conservation strategy to address these matters.

6. Opportunities for cooperative research, planning and management efforts are numerous, even though Canada, Denmark, the US, and others are working jointly on some projects now. Transboundary heritage areas exist, for example between Alaska and Yukon (North Slope National Park and Arctic Wildlife Area) but could be used more effectively. A good opportunity exists for a joint or "Peace Park" arrangement between the proposed Ellesmere National Park in Canada and the North Greenland National Park on the other side of the strait. Tourism patterns and effects were a concern for many at the Symposium and opportunities for joint research exist in this regard.

7. These *Proceedings* have been prepared for publication as a basis for improved research and public understanding. It is also planned to continue to approach decision-makers in regard to the various Symposium conclusions. Some radio and television interviews are also planned.

8. With regard to follow-up on the Arctic as a Regional Sea, several authors and commentators strongly supported this idea. The networking, cooperative research, planning and management that is possible under this institutional model are indicated in an article (Nelson and Needham, 1985) in the Appendix.

9. With regard to follow-up on an International Forum for Universities for Northern Studies, the future is also uncertain. As noted earlier, the ACUNS' Board has an interest but resources are a problem.

10. In this context it is important to address briefly another concern that the ACUNS' Board has had for some years, i.e. more university contact with native people and northern residents, not just on heritage but research, education, training, and information generally. Reference has been made previously to the Northern Studies Trust, Native Studentships, and ethical guidelines for research. In organizing the Symposium a concerted effort was made to have northerners attend. Our efforts were constrained however by funding problems. Some indigenous people and northern residents were at the Symposium. A valuable paper was submitted by Tungavik Federation of Nunavut. ICC members were involved and we hope these Proceedings are useful to them. Other invited northerners could not come. We, as organizers, were committed to a significant amount of such participation at the Symposium. ACUNS continues to carry forward its efforts in this regard, notably through the 1986 Annual General Meeting in Yellowknife.

Opening Remarks for the Arctic Heritage Symposium

J. Gordon Nelson, Symposium Moderator

Welcome and thanks

Welcome to this symposium on Arctic Heritage. This is a unique group for a unique and hopefully meaningful event. Many of you are from Canada but many also are from other parts of the world. The international flavour of our group is exemplified by some participants who have come unusually long distances to participate in the Symposium. Among the international participants are Jennifer Baker of the Field Studies Council, UK; Bernd von Drost, Unesco, Paris; Eugene Lapointe, CITES, Switzerland; Richard Stenmark, National Park Service, USA; Nicholas Polunin, Foundation for Environmental Conservation, Switzerland; and several persons from Greenland, Norway, and the IUCN, Switzerland.

Motivation

This Symposium is the third offered by the Association of Canadian Universities for Northern Studies (ACUNS) as a contribution to the greater understanding and solution of northern problems. It is the first to explicitly reach out into the international domain and attempt to build bridges among northern nations on a theme of great common concern: Arctic Heritage. It is also a response to the growing interest in this topic arising largely from much ongoing and proposed development and change in many parts of the arctic area.

For us heritage is a broad concept, embracing both the human and the natural spheres as well, indeed, as their interactions. It is not seen as a static concept, nor an artifactual one. Rather, heritage is seen as a force from the past, a source of meaning, a basis for judgement about things of the present and future.

These notions are reflected strongly in the Symposium papers and no more need be said in this regard now. It is being convened about one week before the Canadian Assembly, a "grassroots" meeting, celebration, and evaluation held as part of the Centenary of the establishment of Canada's first national park at Banff, in November 1885. The results of this

Symposium will be carried to the Canadian Assembly in Banff, 5-8 September, 1985. The results will also be promulgated via *Proceedings*, and other representations to interested and responsible persons.

The Symposium has the following specific purposes, as noted in our original brochure:

1. A vigorous exchange of ideas: clarification of what we know and do not know about heritage use and conservation in the circumpolar area.
2. Learning from the experience of other countries, to the mutual advantage of all.
3. Identification of possible cooperative planning and management efforts, for example, in regard to international parks and wildlife areas, or scientific reserves for monitoring or other purposes.
4. Publication of *Proceedings* as a basis for improving research and public understanding.
5. Follow-up on the Arctic as a Regional Sea.
6. Follow-up on an International Forum for Universities for Northern Studies, paralleling the Association of Canadian Universities for Northern Studies (ACUNS) in Canada.

The Program

The program is organized to provide a basic background in the Natural Realm, or, if you will, the physical and biological aspects of our topic. This is followed by a discussion of past and present land use changes and human interaction, and then by consideration of some planning, institutional and management initiatives and their effects. In essence, the program is a human ecological approach to arctic heritage, with the institutional and management focus being on international conventions and agreements and more completely on the role of national parks and protected areas.

The Symposium is intended to focus on scientific, technical, and knowledge aspects of heritage, as befits the contribution to be expected from a university organization such as ACUNS. However, we fully recognize the diverse sources of information–the uniqueness and great importance of indigenous knowledge–and the need to marry traditional science and traditional knowledge more completely and effectively. We have attempted to build indigenous concerns and contributions into the program.

A Working Committee will be struck to receive and develop ideas, suggestions, and recommendations on matters arising during the Symposium. These conclusions will be discussed at a Plenary on the final day of the meeting.

* * *

Welcoming remarks were then made by representatives of the organizations responsible for the Symposium as well as brief introductory remarks by Marc Adelard Trembly, President, Association of Canadian Universities for Northern Studies; Harold Eidsvik, Chairman, Commission on National Parks and Protected Areas, International Union for Conservation of Nature and Natural Resources; Jose Furtado, Chairman, Commission on Ecology, International Union for Conservation of Nature and Natural Resources; and Roger Needham, Symposium Coordinator.

Editorial Note

In preparing these *Proceedings*, several volunteered papers, which were presented together in a special session, have been incorporated into the original Symposium session considered most appropriate from the standpoint of subject matter. Thus Thomas is in The Natural Realm, Marsh in the land use session, and so forth. In reading the critics remarks, the foregoing point should be kept in mind, as well as the fact that sometimes critics did not get papers in time to comment upon them adequately.

Major Conclusions

Working Committee Members

After detailed discussion the following conclusions were accepted by the Plenary Session on the last day of the Symposium.

To ACUNS and other northern university organizations

1. Given the success of this first symposium in bringing together persons with diverse interests in research on natural and human aspects of the arctic area, an Arctic Heritage Forum should be created to meet every two years to discuss research and its implications for Arctic Heritage and to promote communication and advances through a membership network, a newsletter and other means. The Forum should be developed in consultation with Unesco's Northern Science Network and other relevant bodies.

2. A Circumpolar Universities Group should be organized to hold seminars, discussions and promote exchanges and other cooperative activities. The group should hold an international conference at 2-3 year intervals on key research or educational topics. In this regard it is suggested that the first meeting consider communications in its technical, social, environmental and other aspects because of its growing importance and its uncertain implications for northerners and others interested in understanding and working with them.

3. In order to promote better relations and better serve northern peoples, ACUNS should plan and hold regular workshops on topics of common interest, in collaborating with northern groups and agencies. The forthcoming meeting of ACUNS in Yellowknife provides the first opportunity to develop this idea.

4. ACUNS and other northern university organizations should study the possibility of developing a co-ordinated inventory of ongoing research related to fields such as Arctic Heritage.

5. ACUNS and other northern universities should collaborate with northerners in the development of Regional Heritage Resource Strategies of the type advocated at this symposium for northern Sweden. Such co-operation should involve possible development of clearing

houses, data banks, and other research and information tools in collaborating with appropriate research agencies, for example the Northwest Territories (NWT) Science Institute in Canada.

6. To promote dissemination of the many ideas and detailed recommendations made at the Symposium through prompt publication of the *Proceedings* which should immediately be sent to conference participants, the media, key decision-makers, and others who could use or benefit from the findings. An attempt should also be made to spread the results more vigorously through radio, TV or other northern programming, in the manner being developed by ACUNS in cooperation with CBC.

To Canadian Federal Government and especially Departments of Environment and Fisheries and Oceans

1. Having discussed several international agreements/conventions pertaining to Arctic heritage or related matters and having learned of the aborted proposal to hold a study workshop on the range of available agreements/conventions and their scope and effectiveness, the Symposium recommends that this initiative be reconsidered and held, preferably in association with the 6 June 1986 World Conservation Strategy meeting in Ottawa.

To ACUNS, Inuit Circumpolar Conference (ICC) and Other Comparable Northern Organizations

1. Having recognized the mutual research, education, information and other social benefits to be derived from closer cooperation between universities and indigenous peoples, the Symposium urges ACUNS and indigenous organizations such as The Inuit Circumpolar Conference (ICC) to develop standing liaison committees or other regular means of communication and cooperation.

To IUCN

1. To establish an Arctic Working Group with the Commission on Ecology or a comparable body in order to more effectively address northern issues, and to facilitate doing so in collaboration with ACUNS and other interested research groups.

2. To study the applicability of Antarctic treaties, conventions and agreements for research, information exchange and resource and environmental management in terms of their applicability to the Arctic area.

3. To continue the development of the inventory of national park and protected areas through the IUCN Conservation Monitoring Centre in order to assist governments and other interested agencies in developing a comprehensive arctic heritage system and provide a basis upon which specific cooperative programs can be pursued.

To all Government and Non-Government Groups Interested In and Responsible for Arctic Heritage

1. In recognition of the value of research in both undisturbed and disturbed environments, the opportunities for more collaboration among universities, government and industry, the need for monitoring and multi and interdisciplinary studies, the importance of arctic areas as unusually resonant recorders of and benchmarks for global climatic and other changes, and the need for long term research as a basis for greater understanding, the Symposium recommends that several high Arctic areas be made the focus of long term coordinated research. Such activity should be facilitated by stronger commitment to research as a basic use of national parks, national Canadian wildlife areas or other heritage management areas. Unesco's Man and Biosphere Programme (MAB) could be used more frequently to encourage this type of research.

2. The Symposium strongly supports the development of a more complete and flexible Arctic Heritage Area system, with greater use of national wildlife areas, larger territorial parks, Biosphere Reserves and other institutional arrangements designed to manage areas with different physical, biological and cultural characteristics as well as different resource use patterns and prospects. In this regard, the Symposium supported many of the recommendations in the recent Canadian Northern Conservation Task Force Report. In particular, the Symposium urges identification and development of environmentally significant areas in coasts and marine areas, as well as lakes and rivers, as such systems are not adequately represented in current parks and other types of heritage management areas.

3. The Symposium strongly urges greater collaboration among Arctic nations in the study, establishment and management of heritage are-

as, particularly transboundary heritage areas, in which to provide for sustainable use of migratory fauna and other dynamic elements of northern ecosystems. Such collaboration should be conducted in consultation with local populations because of their special reliance on certain species. In this regard the point was made that species vary in their relations with different peoples and areas. Many terrestrial mammals move largely within the domain of a territory or a nation. However, some terrestrial mammals and many birds and marine mammals migrate over great distances, are used by and contribute to the heritage of many separate peoples and nations and must be viewed and managed as a global inheritance.

4. Recognizing the frequently weak funding and staffing of heritage area programs, which prevent their effective implementation, even though apparently adequate "on paper", the Symposium strongly supports better funding of Arctic Heritage programs, and also communications activities designed to promote greater understanding of their importance to renewable resource users, recreationists, tourists, scientists and educators, as well as other users within and without the Arctic.

To Regional Seas Programme and UNEP

1. Recognizing the opportunity for and necessity of cooperative intergovernmental research, planning, and management, in regard to arctic heritage resources, and related matters such as oil spills and marine pollution, the Symposium urges The United National Environmental Program (UNEP) to initiate an Arctic Regional Seas Programme, through workshops and the development of a convention and appropriate protocols in the manner of the Mediterranean and other regional seas of the world.

Working Committee

J.G. Nelson
R.D. Needham
Peter Adams
Nicholas Polunin
George Francis

***

Developments Since Symposium

Since the Symposium the ACUNS Board has considered the foregoing conclusions and has written letters and made representations to appropriate agencies in regard to many of them. The Board decided it could not accept responsibility for a specialized activity such as the Arctic Heritage Forum, believing it to be more appropriate for an agency such as IUCN. The Board is positively disposed toward the other conclusions directed to it, with reservations about its role in regard to a coordinated inventory of ongoing research because of the scope, cost, and need for extensive collaboration with many groups. Upon publication of the Symposium Proceedings ACUNS will make inquiries with interested parties about a possible workshop to address the Symposium recommendations.

THE NATURAL REALM IN THE ARCTIC

Prince Leopold Island
Courtesy: Parks Canada

Climatic Variation and Change and the Implications for Arctic Heritage Planning Strategies

Ellsworth F. LeDrew

Introduction

In response to the global concern regarding debilitating droughts and attendant food crises, scientists investigating climate variability and change have recognized several basic principles. Among them are (Bolin, 1979a; Fedorov, 1979; Lamb, 1982):

- variability of climate has a demonstrable effect on human well-being;
- on a local scale, humans can now influence climate with an effect that is significant in comparison to the natural variability;
- human impact will escalate to have global consequences;
- inadvertent impact typically leads to increasingly adverse results;
- the potential for geopolitical disorganization and conflict is great.

The great sensitivity of arctic climates to variability and change is a significant factor in the scenarios that have been developed to study the global implications of these statements.

From a climatological perspective, sensitivity refers to the low thresholds involved in transitions to new atmospheric regimes or the responsiveness to a change in signal. There is a suite of feedbacks between the cryosphere, ocean and atmosphere that contribute to the enchanced sensitivity of the Polar processes. As a result, any natural or anthropogenic perturbations within the climate system are amplified in arctic regions. For example, the 1942 to 1972 surface temperature trend north of 50° was seven to eight times the hemispheric average (van Loon and Williams, 1976). This amplification may in turn influence the global circulation by increasing the north-south temperature gradient. The sensitivity of the climate system within the Arctic, has become a major focal point of research.

In his commentary on this paper at the Symposium in Banff on 23 to be that which we receive from our predecessors and that which we will pass on to our successors. He noted that this implies that we must study how we currently value the Arctic and how we are to exercise the responsibility to pass on the Arctic to the future with enhanced value.

In the following, I will review aspects of the sensitivity of the arctic climate and the implications for variability and change. Because of the amplification of any perturbation in the Arctic through the enhanced sensitivity, it is important to understand how we can advertently or inadvertently affect future climate states. We must also consider how we can in turn be affected by variability and change if we are to make responsible planning decisions regarding our Arctic Heritage.

The intention of this review is to present a climatological framework and to highlight research issues that must be considered in the planning process.

Vulnerability to Climate Variability and Change in the Arctic

If natural climate variability is viewed as a hazard in mid-latitudes (Perry, 1982), the enhanced sensitivity within the Arctic makes it a subject worthy of considerable concern within this environment. Of particular note is the climatic stress imposed upon the ecosystem by variability and change. Since the ecosystem structure and trophic relationships are relatively simple in comparison to other environments, with few alternative energy paths (Barry *et al.*, 1977), there is a strong control by the physical environment. Without a buffering capacity, small climate increments or decrements can have substantial effects (McKay, 1977).

For example, a relatively warm period from 1100 to 800 B.P., identified as the Medieval Warm Epoch, was associated with the rapid eastward expansion of the Thule culture from northern Alaska. One driving force may have been the open sea conditions which permitted hunting of baleen whales from boats (Barry *et al.*, 1977). From 800 to 400 B.P., a return to cooler conditions roughly coincided with a shift to snow houses and winter seal hunting through ice holes. Today, the economy of an Inuit community falters when a severe ice season, such as that of 1972, results in negligible seal catches (Jacobs, 1975). The history of man in the Arctic is one of adaptation to climate variation (Catchpole, 1978) and the impact of that variation is fast and hard.

Direct linkages between atmospheric processes and migrations of other members of the ecosystem have been identified. The northward penetration of cod along the west coast of Greenland from 1917 to 1933 is related to warmer temperatures and increased larval transport of a stronger Irminger current. This strengthening is a response to increased vigor of the atmospheric circulation (Dunbar, 1976; Ford, 1982). The concomitant displacement of storm tracks is also held to account for the arrival of the Fieldfare in southwest Greenland in 1937 and colonization of Iceland by the swallow in 1930 (Ford, 1978). These milestones can be the result of survival in a small number of favourable years rather than gradual change. Conversely, a single harsh year can be equally damaging and may lead to extinction (Tuck, 1976). The episodic nature of variability is a significant factor in marginal climate regimes such as the Arctic.

As Polar resources become more attractive economically, our vulnerability to climate variability and change becomes more acute. This is due to a limited data base from which to assess reactions to different climate states as well as the severity of a climate related failure. The hazards of the extreme storm surge (Schaeffer, 1966) or severe ice year (Barry *et al.*, 1979) on drilling structures can have disastrous consequences (Wadham, 1976), yet the magnitude of the extreme event and the nature of the formative processes are difficult to determine with confidence because of the inadequate climatologies available for the Arctic.

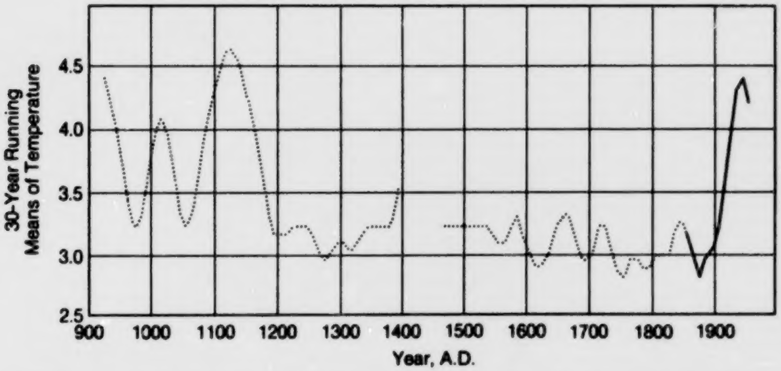

Figure 1 Running 30 year means of temperature at Iceland. The reconstructed data for the period from 1591 to 1846 are based upon a relationship with incidence of drift ice developed from observed data since 1846. A relationship between ice incidence and the number of severe ice years is used to provide the reconstruction between 930 and 1541, except for the period in the 15th century when information is too meager. From Bergthorsson (1969).

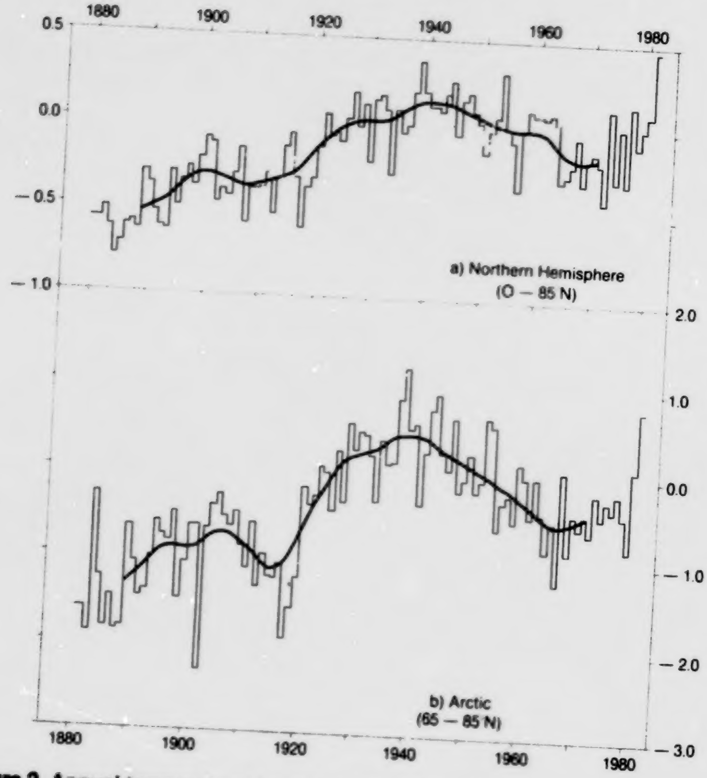

Figure 2 Annual temperature departures from the 1946-1960 mean (Celsius) averaged over the Northern Hemisphere (0-85°N) and the Arctic (65-85°N) (from Kelly et al., 1982).

Climate Variability, Change and Sensitivity in the Arctic

Figure 1 is a reconstruction of the temperature variations for Iceland during the last 1000 years based upon proxy data (Bergthorsson, 1969). This is an interesting illustration for it indicates that the most recent 30 year normal may have been far from that! This warm anomaly has been a period of considerable resource development that is climate dependent.

Figure 2 focuses upon observed data within the anomaly with greater temporal resolution and numerical accuracy. The data are presented as annual departures from the 1946-60 mean with a filtered curve superimposed to clarify trends. A warming up to the early 1940s and subsequent cooling is evident. This relatively small cooling appears to be related to a shift from a zonal to meridional hemispheric circulation in the early 1950s (Dzerdzeevski and Sergin, 1972) with reduced vigor (Lamb, 1972). Because of the lack of data in many key areas, however, particularly over the oceans and in the Arctic, it is not certain whether this is evidence of climate change in response to external variables such as CO_2 concentration, solar output or volcanic dust, or whether it is a natural expression of perhaps random variability (Schneider, 1977) resulting from many internal variables in nonaligned states of oscillation. Also of note is the greater amplitude of the signal in the Arctic in comparison to the Northern Hemisphere–the difference is a factor of three–and the increased year to year variability in the 1970s when the temperatures appear to have returned to the values of the late 1950s and early 1960s (Jones and Kelly, 1983).

With respect to our interests, this evidence of variability or change prompts a critical question: Can we sufficiently define the governing forces to allow useful long range forecasts necessary for planning and development of our Arctic Heritage? The objective is to mitigate any adverse impact of activity in the Arctic and/or accommodate natural evolution with minimal disruption to our activities and the ecosystem. The science of climate prediction is in a youthful state and the answer is no, at the moment.

Figure 3 is a very incomplete conceptual framework for the interactions that must be considered in an understanding of climate processes, which is the first step towards prediction. These processes must be realistically simulated with confident algorithms and accurate forcing data. This is no easy task. In our most elaborate numerical models we can only deal with a subset of this suite and then only as equilibrium solutions or snapshots in time. We cannot yet produce the time evolving solutions which may replicate the gradual change anticipated in the near future as a consequence of CO_2 enhancement (Schneider, 1984), for example.

The sensitivity of the arctic climate to change and variability is evident in the albedo feedback loop at the top of this figure. A regional tempera-

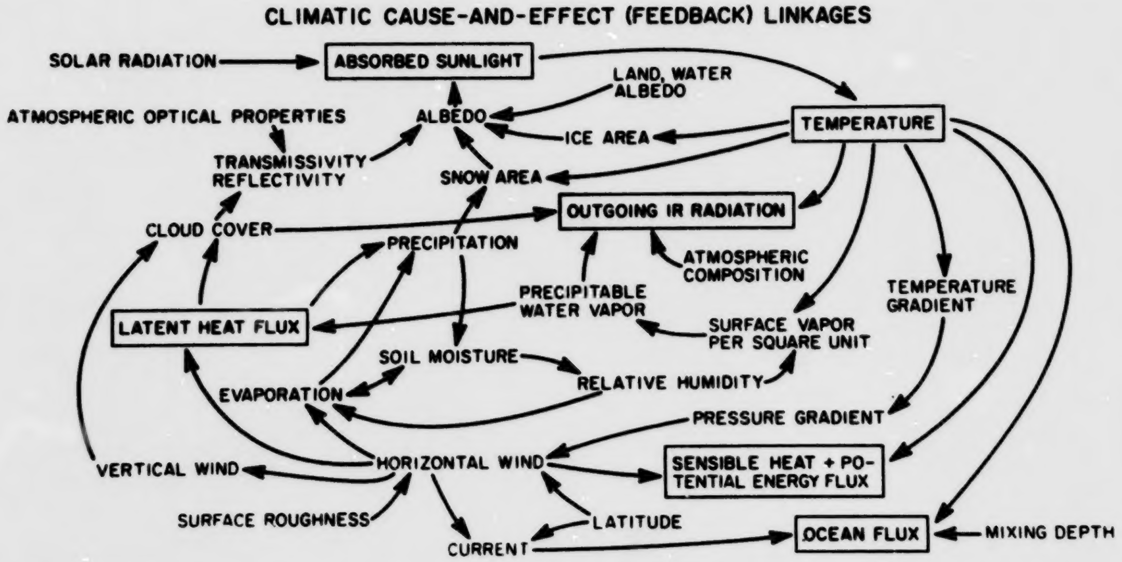

Figure 3 A conceptual model of the major feedback linkages that must be considered in climate processes (from Schneider, 1977).

ture rise would be accompanied by an increase in the atmosphere to surface heat flux. This prompts melting of the highly reflective ice cover which is replaced by the water surface of lower albedo or reflectivity. The increased absorption of solar radiation results in a greater temperature increase. Since a strong surface inversion is typical of the Arctic, vertical mixing of this warmed air is inhibited and the near surface heating rate is augmented even more.

Models incorporating this positive feedback concept with an initial 5°C warming simulate a complete disappearance of the arctic pack ice in August and September and reappearance in winter (Parkinson and Kellogg, 1979). This 5°C warming is one proposal for the greenhouse effect associated with a doubling of the CO_2 concentration. This is expected at the middle of the next century from considerations of fossil fuel consumption. Because of the albedo feedback, the final thermal response in the Arctic was three to four times the mean global increase. Independent model simulations indicate that this amplification would result in a weakening of the hemispheric zonal flow of the atmosphere (Warshaw and Rapp, 1973) with implications for mid-latitude climates. With less zonal available potential energy, there would be weaker synoptic systems that would move more slowly due to a weaker steering flow aloft (D. Etkin, Pers. Comm. 1985).

Recent investigations have indicated that there are negative feedback loops that may dampen this effect at the margins of the pack ice of the Polar Basin. One possibility is that enhanced evaporation over open water as well as steering of cyclones along the sea/ice boundary will lead to increased cloudiness and possible net cooling in this region (Barry *et al.*, 1984). Hence the sensitivity scenario is expanded to include synoptic processes which can include additional and perhaps conflicting feedback loops. An example is the convergence of ice fields under the wind stress of low pressure systems when the ice concentration is high (Hibler, 1974). The convergence of ice fields results in cutting off of much of the energy and moisture exchange between the ocean and the atmosphere which drives the pressure systems. For low ice concentrations there is divergence and the sign of the feedback is reversed.

Several studies have attempted to relate the observed climate signal to sea ice extent to provide insight into these conceptual models. At Laurie Island, at 60° south, a 1°C change in mean annual temperature is associated with a 70 day variation in sea ice duration (Budd, 1975). Barry *et al.* (1979) found the extent of open water off Barrow, Alaska, to be correlated with accumulated thawing degree days. A linear extrapolation for a 5°C summer warming would imply a significant open water increase from the present 150 kilometres offshore to 600 kilometres.

The explanation for these ice-atmosphere relationships is not clear. Zwally *et al.* (1983) believe that strong regional contrasts in the variability of antarctic sea ice indicate that observed changes are attributable to regional atmospheric and oceanic circulation patterns as opposed to a global warming. Studies of ice anomalies in the East Greenland Sea have illustrated that the strength of the Icelandic low as well as the regional temperatures of the preceding winter are important contributing factors (Barry, 1983). Within Baffin Bay the mix of ocean currents feeding the region may be significant (Dunbar, 1976). These currents are a function of the position and intensity of the Icelandic low. Because of this complex linkage between sea ice, the ocean currents and the variability of weather systems tracking through the Icelandic region, the natural variability of sea ice is greater in the Eastern Canadian Arctic than in other Arctic seas (Lemke *et al.*, 1980).

The large anomalous polynya at the head of Baffin Bay known as the "North Water" (Dunbar, 1969) is a special and perplexing example of the feedbacks between sea ice, the ocean and the atmosphere. It is large enough to have a distinct ameliorating effect on the regional climate and the enhanced heat flux from the open water is strong enough to spawn cyclones. The energetics appear to be dominated by oceanic input, however, (Mueller, 1976; Mueller *et al.*, 1976) which in turn is partially forced by the atmosphere elsewhere. A complete explanation still eludes us. This is an ideal test region to sort out the linkages.

One possible significance of reduced sea ice cover is that the attendant albedo reduction over large areas of the Arctic forces adjustments in the global circulation. Numerical simulations (Herman and Johnson, 1978) indicate that reduced ice may force northward displacement of cyclone tracks resulting in less precipitation over Europe. Flohn (1982) postulates a linkage to shifts in sub-tropical anticyclones which Bryson (1973) believes to be related to droughts in the Sahel. There is recent evidence, however, that the January position of the Hadley circulation varies little between different climate simulations, which implies that stabilizing Feedbacks may be involved (Rind, 1986).

The converse albedo effect, resulting from an anomalous expansion of snow cover, is believed to be a causative factor in the global weather anomalies of 1972-73 (Kukla and Kukla, 1974).

A large body of literature on ice-atmosphere interactions has been developed. Themes include:

- the importance of ice/sea contrasts in explanations of local climate (Ohmura, 1982);
- the implications of trends in sea ice extent for climate change (Rouse and Bello, 1985);

- the teleconnections with circulation processes elsewhere around the hemisphere (Rogers, 1978);
- the relationship between sea ice patterns and synoptic patterns (Scherhag, 1936; Keen, 1977; Crane, 1978, 1983; Crane *et al.*, 1982; Walsh and Johnson, 1979).
- and the role of the thermal contrast across the ice/sea boundary in development and steering of cyclones (Overland and Pease, 1982; LeDrew, 1983, 1984, 1985; Carleton, 1985).

We are far from agreement with respect to cause and effect in understanding the ice-atmosphere process linkages (cf. Walsh, 1983). Considering the highly nonlinear state of the climate system (Figure 3), it may not be possible to sort out cause and effect.

The role of the cryosphere may be the most significant focus of research into climate variability and change in the Arctic. Because of the associated sensitivity, the importance with respect to the effect on global climate is out of proportion to its geographical area.

Points of Human Intervention

This discussion of sensitivity and the cryosphere is important for it emphasizes the consequences of small perturbations which may be natural or man-induced. Table 1 (adapted from Schneider and Londer, 1984) highlights many sources of man-induced perturbations. These points of human intervention, which may be viewed as points of leverage on the climate system, are worthy of study since, in effect, we are performing an experiment on the "real world" with no fall-back position. The experiments range from advertent effects such as diversion of rivers flowing into the Arctic Basin, with unknown consequences (Barry, 1981), to inadvertent effects such as the recently highly publicized CO_2 greenhouse effect.

Despite a long history of study (eg. Plass, 1959), there is a great deal of uncertainty surrounding the CO_2 question which is especially disconcerting since we are in the middle of the actual experiment. This uncertainty involves the role of biosphere sources and sinks (Bolin, 1979b; Bach, 1979) as well as the impact on climate (Schneider, 1984).

One approach to determining the effects on the atmosphere is through numerical simulation using a global General Circulation Model or GCM. Depending upon the resolution of the model, the nature of the parameterization and the method of handling the different temporal scale of oceanic processes, the results may vary considerably. In all cases, the sensitivity of the Arctic figures prominently.

Table 1 Summary of principal human activities that can affect climate (from Schneider and Londer, 1984)

Activity	**Climatic Effect**
Release of carbon dioxide by burning fossil fuels	Increase the atmospheric absorption and emission of terrestrial infrared radiation (greenhouse effect) resulting in lower atmosphere warming.
Release of cholorluoromethanes, nitrous oxide, carbon tetrachloride, carbon disulfide, etc.	Similar to greenhouse effect.
Release of aerosols from industrial and agricultural practices	Decrease albedo over land resulting in a warming and increase albedo over water resulting in a cooling.
Release of aerosols that act as condensation and freezing nuclei	Influences growth of cloud droplets and ice crystals; may affect amount of precipitation or albedo of clouds in either direction.
Release of heat (thermal pollution)	Warms the lower atmosphere directly.
Upward transport of chlorofluoromethanes and nitrous oxide into the stratosphere	Photochemical reaction of their dissociation products probably reduces stratospheric ozone.
Patterns of land use, e.g., urbanization, agriculture, overgrazing, deforestation, etc.	Changes surface albedo and evaporation and causes aerosols.
Large-scale nuclear war	Could lead to large injections of soot and cooling lasting several weeks or so, depending on the nature of the exchange and how many fires were started.

A recent simulation by Hansen *et al.* (1984) (Figure 4) includes a reasonable consideration of eddy mixing of heat in the ocean. A doubling of the CO_2 concentration results in a mean global surface warming of 4.2°C. The snow/ice albedo feedback accounts for 1.3°C of this total. From the figure we see that surface warming is enhanced at high latitudes, owing to the confinement of heating to the lower atmosphere as a result of the high atmospheric stability as well as the albedo feedback. The annual change over Northern Canada is more than 5°C whereas it is less than 4°C in the tropics. There is also an enhanced seasonal variation at high latitudes because of the seasonal change in this stability.

S. Cohen of the Canada Climate Centers (1984) has reviewed several GCM results and collated the statistics for various sectors of Canada. In the west Arctic, the summer warming attributed to a doubling of CO_2 (one-half of a four times simulation) ranges from 1.5 to 2.5°C. In the east, it is greater, ranging from 2.3 to 3.°C. On the other hand, summer participation in the west increased by 10 to 100%, while in the east the increase is reduced by 3% to 20%. The precipitation data may be questionable because of the linkage to aspects of the large scale flow in the simulation which cannot be scaled down from a four times to a two times CO_2 warming by simple division of the results.

Figure 5 is the two times January CO_2 warming from the Geophysical Fluid Dynamics Laboratory (Princeton, N.J.) GCM experiment. The contours are superimposed on a map of the Canadian National Parks to highlight regions of national interest and coordinated planning (data courtesy of the Canadian Climate Center and map from Constable, 1985). Figure 6 is a similar map with the results of the two time CO_2 warming from the Goddard Institute of Space Studies experiment. Both are the results of state of the art simulations and yield markedly different patterns at this scale. Of particular interest is the disagreement of up to 5°C over the western provinces and smaller but still significant differences over the Northwest Territories. Clearly we are not prepared to provide unequivocal answers regarding long term atmospheric evolution for planning. We do not understand the climate processes sufficiently.

To provide working objectives for the modelling scientists, what we need to determine with assistance from the arctic planning community are:

- What climatic variables are of priority interest?
- What numerical confidence in prediction is required?
- For which seasons are data necessary for specific areas?
- What is the monetary as well as intrinsic value of the answers?

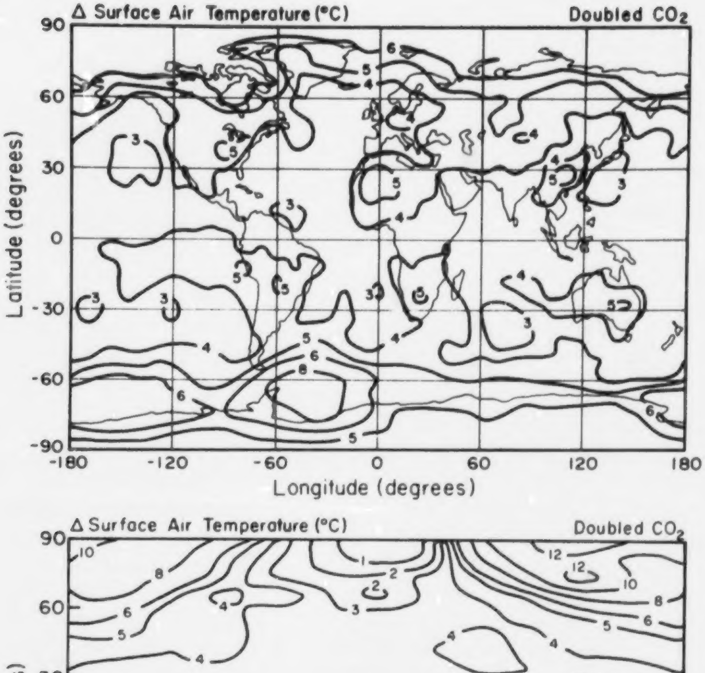

Figure 4 Model simulated global warming for a two times CO_2 loading. Annual warming (top) and seasonal variation averaged by latitude bands (bottom) (from Hansen et al., 1984).

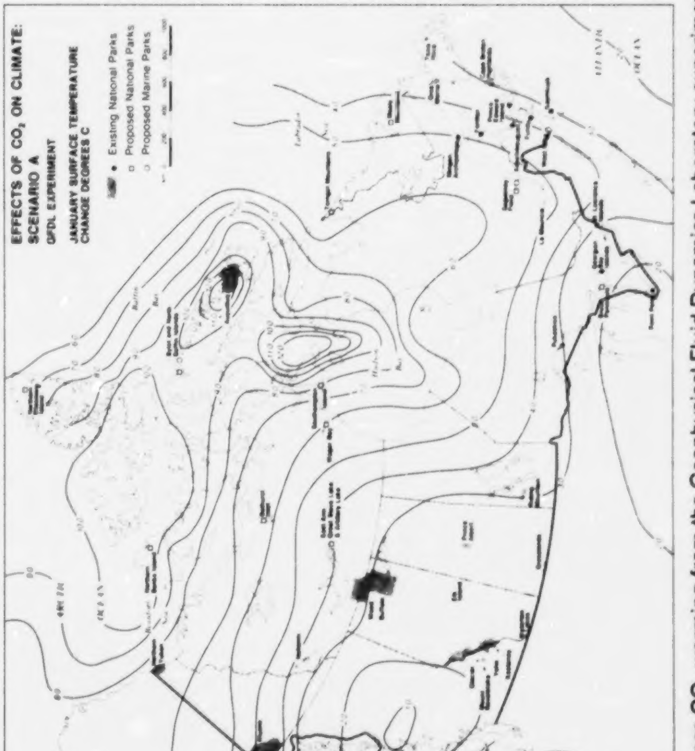
EFFECTS OF CO₂ ON CLIMATE:
SCENARIO A
GFDL EXPERIMENT
JANUARY SURFACE TEMPERATURE CHANGE DEGREES C
● Existing National Parks
□ Proposed National Parks
○ Proposed Marine Parks
Baffin
Bay
Hudson
Bay
ARCTIC
OCEAN
PACIFIC
OCEAN
ATLANTIC
OCEAN

Figure 5 Two times CO_2 warming from the Geophysical Fluid Dynamics Laboratory experiment superimposed on a map of the Canadian National Parks (Contoured data are courtesy of the Canadian Climate Center and the map is from Constable, 1985).

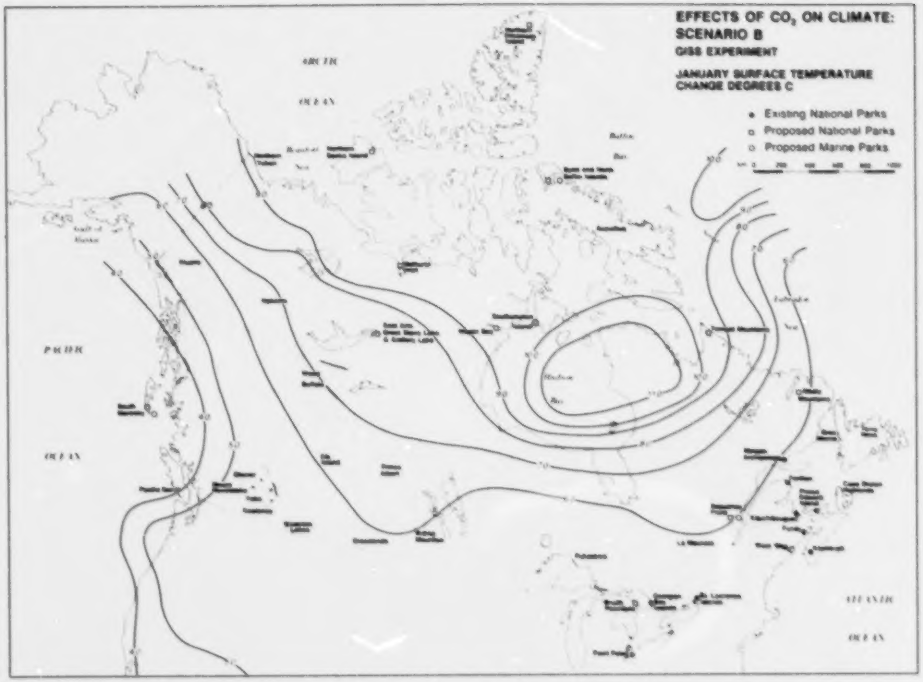
EFFECTS OF CO₂ ON CLIMATE:
SCENARIO B
GISS EXPERIMENT
JANUARY SURFACE TEMPERATURE CHANGE DEGREES C
● Existing National Parks
○ Proposed National Parks
○ Proposed Marine Parks
ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
Baffin Bay
Hudson Bay
Labrador Sea

Figure 6 Two times CO_2 warming from the Goddard Institute of Space Studies experiment superimposed on a map of the Canadian National Parks (Contoured data are courtesy of the Canadian Climate Center and the map is from Constable, 1985).

These GCM results are snapshots or equilibrium models. They are possible answers to "what if" questions regarding a particular state in the future. They do not provide information on the transient state we are in at the moment which Mitchell (1982) considers to be the most crucial time period in terms of potential for geopolitical destabilization.

An alternative to simulation models is to view "analogues" in the past. The assumption is that the atmosphere would respond to a future warming in a fashion similar to the response to past warmings. A study of past circulation patterns then would be the basis for a valid forecast. An extreme case is the Tertiary when CO_2 levels were 2 to 10 times the current values (Budyko and Yelimova, 1981) but there are many complicating factors in translation to the current situation including a different geography.

Williams (1978) studied warm year anomalies from 1899 to 1972 in an effort to view the spatial consequences of a presumed global warming using observed data. In Figure 7, we see a composite of the ten warmest winters with a statistically significant cool anomaly of 1°C in eastern arctic Canada. From a study of the associated pressure maps we see that this is attributable to increased northern flow in this sector which is balanced by increased cyclonic flow from the Northern Atlantic into the Eurasian sector of the Arctic. The summer data are less significant with anomalies greater than 1°C found in few areas. This seasonal distinction is consistent with considerations of Arctic sensitivity and the results of numerical simulations (e.g. Hansen *et al.*, 1984, Manabe and Stouffer, 1984). Schneider (1984) cautions, however, that these effects are not CO_2 induced, as evidenced by the lack of a coherent global warming, and they may be the result of normal internal variation versus external CO_2 forcing–i.e., they are not true analogues.

A disturbing insight in terms of future planning is related to the role of the time lag in the thermal response of the atmosphere induced by eddy mixing of the heat at the ocean surface. This lag may approach 40 years. Hansen *et al.* (1984) suggest that even if CO_2 and trace gases cease to increase at the present time, we already have a 1°C warming down the pipeline as a result of past loadings, and if we continue to inject gases, the "...gap between current climate and the equilibrium climate for current atmospheric composition may grow rapidly in the immediate future..." Since the heating and the mixing of the oceans is greatest in summer, the gap will close, causing a greater atmosphere heating effect during that season.

These arguments have been expanded to include trace gases such as chlorofluoromethanes and N_2O gas so that we now speak of a "Virtual CO_2" effect (Flohn, 1980). Lacis *et al.* (1981) compute the warming in the 1970s resulting from these gases to be nearly as large as that computed from the CO_2 increase. After consideration of natural sinks, this total heating is approximately 0.1°C for the decade. Unfortunately, this is less

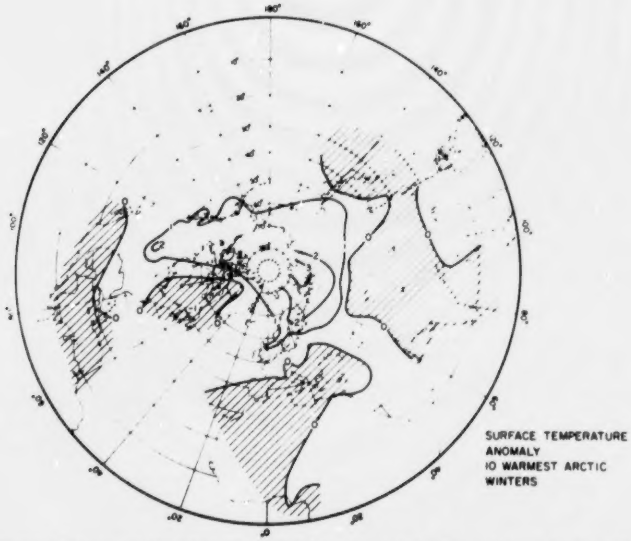

Figure 7 Temperature anamolies for the 10 warmest Arctic winters in the 1900 to 1969 period (from Williams, 1979).

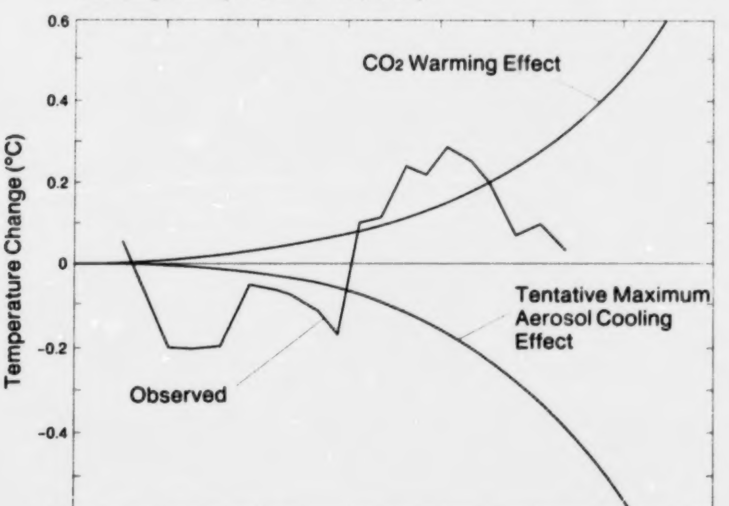

Figure 8 Observed temperature variation during the past century. Superimposed on this record are model predicted trends for a CO_2 warming and Aerosol cooling (from Mitchell, 1975).

than the "noise" level of the climatic signal. The forecast for the 1980s, however, is a 0.2 to 0.3°C warming which is two times the normal decadal variability. The authors expect to see verification of the net affect within the next ten years. This welcome optimism is tempered by observations of considerable variation in the natural variability (Lamb, 1982) which may cast doubt on the interpretation. Schlesinger (1982) expects first detectability to be in the 2025 to 2053 time interval.

The effect of aerosols is less clear. They increase the planetary albedo over mid latitude and tropical surfaces yet decrease it with attendant heating over bright snow and ice (Chylek and Coakley, 1974). Furthermore, measurements indicate that aerosol content has doubled between 1910 and 1970 over the North Atlantic but there has been little change over the South Pacific (Cobb and Wells, 1970). There is therefore a highly non-uniform geographic effect compounded by a non-uniform geographic distribution of the aerosols.

Bryson (1972) believes that 63% of the temperature variance over the last century can be attributed to volcanic aerosols. The 1963 eruption of Mt. Agung in Bali had measurable effects on the global temperature record (Newell, 1970) which would be exacerbated in the Arctic because of the long atmospheric solar path length and longer persistence of an atmospheric loading. Bradley and England (1978) noted that the diffuse solar radiation component at Resolute reached the maximum record levels in 1964 and the associated step change in climate had a noticeable effect on glacier mass balance in the high Arctic.

Calculations of temperature trends resulting from CO_2 and aerosol loading (Figure 8) indicate that, if the two are additive, there may be a negligible net effect in the short term. This is a point of considerable controversy. Considering the long-term prospects, some believe that whereas the CO_2 effect may enter a relaxation phase after 100-200 years (Mitchell, 1982), the aerosol loading replenished from topsoil and volcanic dust as well as increasing human activity will undoubtedly persist or increase, albeit in cycles. Lamb (1982) notes that the evidence "...reinforce(s) the lesson... that the effect of volcanic matter in the stratosphere in cooling the surface climate may bulk larger and possibly a good deal larger vis-a-vis the carbon dioxide warming effect than is commonly assumed today."

Another point of leverage is through modification of the land surface, the study of which is an enduring geographic tradition. An important linkage to climate in the Arctic is illustrated by the sharp discontinuity in albedo or reflectivity across the tree line between the snow covered tundra and the Boreal forest with snow hidden beneath the closed crown (Hare and Ritchie, 1972). The abrupt difference in radiation absorbed (Figure 9) accounts for a parallel difference in above ground biomass.

The consequent enhancement in structural contrast strengthens the energy difference through bioclimate feedback. On a synotic scale, there is a fur-

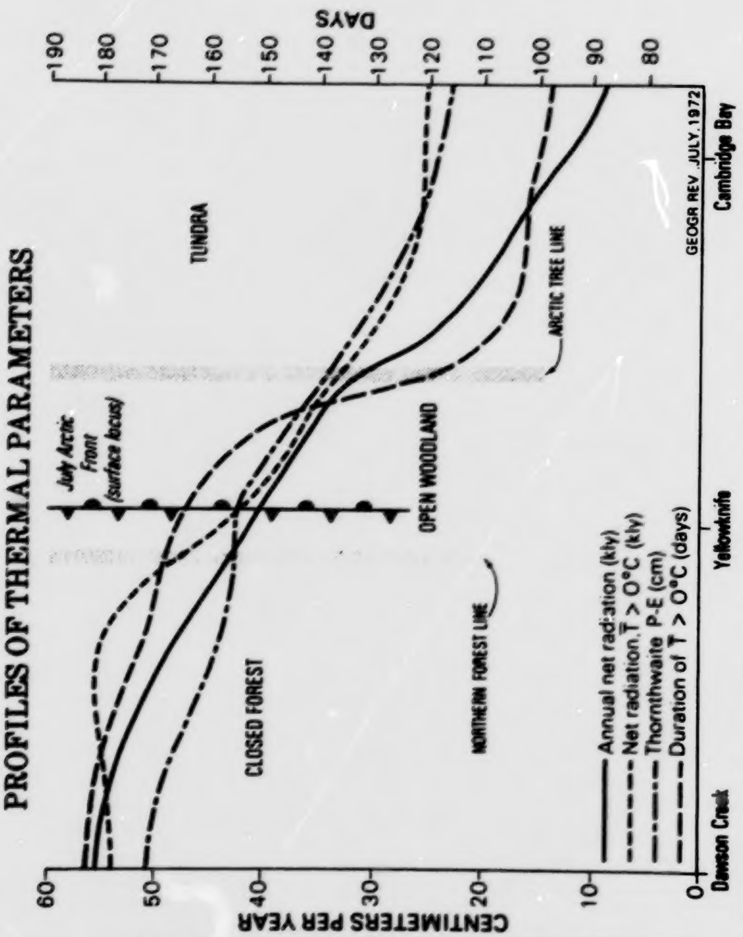

Figure 9 Transect of radiation and thermal variables across the Forest-Tundra Ecotone (from Hare and Ritchie, 1972).

ther, not fully understood, feedback linkage with respect to the atmospheric fronts which parallel the tree line in central and western Canada (Bryson, 1966). It is therefore probable that removal of tracts of the Boreal forest through fire and replacement with shrubs and tundra species can have significant effects on the regional energy regimes and climate. Schmitt *et al.* (1974) considered an extreme case of modification and estimated a reduction in hemispheric absorbed solar radiation by a significant 0.84% if the Boreal forest were removed by drought related fire.

These feedbacks have not received the same depth of study as counterparts in the Sahel where linkages between man's modification of the vegetation cover, desertification and drought is postulated (Charney, 1975; Charney *et al.*, 1975; Sud and Fennessy, 1982). The African situation may not be as extreme as that at the Forest-Tundra Ecotone.

Immediate Scientific Objectives

Natural and man-induced disruptions to the climate system are not necessarily negative. Some are inevitable and the effects of all perhaps are no different from what has been experienced in the past at one time or another. Recall from Figure 1 that we are currently in what may be considered a climate anomaly. The challenge is to view these changes within the context of a populated planet.

In view of the global stresses from all quadrants, including needs for food, exploration and transportation planning, what is disconcerting is the lack of information regarding present processes and future states. We are just now recognizing one part of the problem of climate sensitivity and we can deal effectively with only a fraction of what we recognize.

In a recent address, a senior industry executive noted that one forecast of the CO_2 effect was that the two great losers of precipitation would be the superpowers. His concern was that international cooperation which "... has eluded our grasp to date" would be necessary (David, 1984). Furthermore, there may be long-term effects of a global warming on settlement as well as patterns of international trade in food and fiber (Clark *et al.*, 1982). Are we in a position to make the forecasts necessary for the requisite policy development? Our current analyses are subject to lengthy criticism of fundamental issues (e.g. Schneider, 1984) which is welcome within the natural sciences but less comforting within the policy sciences. Our goal must be to be able to predict consequences with a level of precision that is appropriate to decision making (McKay and Allsopp, 1981).

The problem is exacerbated in the Arctic because of the degree of sensitivity discussed, the concomitant uncertainty with respect to the final outcome, and perhaps of greatest concern, the lack of data for adequate analysis.

The history of data collection in the Arctic has been reviewed by Barry (1983). The significant milestones have been the two International Polar Years (1882-83; 1932-33) and the International Geophysical Year (1957-58). This is a long but broken history; it has only been since the Ptarmigan flights of 1952 that we have had any information on the upper-air structure of synoptic systems (Reed and Kunkel, 1960) which is the key to analysis of processes. The observing network established at the end of World War II was widely spaced and biased towards coastal stations (Bradley and England, 1978). Even today there are significant errors in regional analyses (Albright, 1978). The provision of an adequate Arctic data base for the First GARP Global Experiment (FGGE) in 1978 was a principal objective of the Polar Experiment of the late 1970s (Weller, 1974).

We have gained considerable insight into Polar processes as a result of very recent developments in all-weather remote sensing (cf. Barry, 1981). Because of the cloud penetration capability of microwave sensors, we have almost continuous surveillance of large tracts of previously inaccessible regions. Discrimination of multi-year ice versus first year ice versus open water is possible. Canada's initiative in the development of Radarsat with a planned launch in 1990 answers a long standing navigation and scientific need for timely information regarding sea ice.

Satellite imagery is also considered to be an important data source for mapping surface variables significant in climate analysis. It is crucial for the improvement of our model simulations and study of atmospheric processes. Recently, there has been an integration of the climatology and remote sensing community under the sponsorship of WMO, UNEP and COSPAR with the expressed objective being to use remotely sensed information in the solution of critical climate problems involving variability and change (Rasool and Bolle, 1984). Unfortunately, the Arctic focus has not received the same emphasis as desertification and deforestation topics.

We must be cautious when using these data in policy development. Even if the expected effect of one process could be identified through simulation analysis, the extraction of the trend from the historical observational record for verification would be questionable because of the high signal to noise ratio in the climatic data. Any variation of less than 0.5°C is hard to detect with less than a decade or two of data; and for that there may be many competing physical explanations (Schneider, 1984). Within a given record, there may be several climatic signatures. We may be optimistic in the Arctic, however, where the signal to noise ratio is lower than that for mid latitudes (Wigley and Jones, 1981).

The reliance upon synthetic results of General Circulation Models is also open to criticism because the effect being simulated may have a result smaller than the error limits of the calculations. Such is the case with addition of anthropogenic heat. There may be a limit to the calculability of climate (Bach, 1979). Furthermore, is 1/4 of the results of a 2 time CO_2 increase simulated in a "snapshot" model (e.g. Figures 5 and 6) equivalent to a 25% CO_2 increase with our present exponential growth (Schneider, 1984)? Considering all the factors contributing to the natural variability it is doubtful that in reality we will be ever in an equilibrium state which is what GCM's are particularly suited to simulate. A considerably different "transient" state will be the usual condition.

Perhaps the most promising approach to consideration of the effects of impact is that of scenario analysis (Schneider, 1982). The purpose is "... not to predict future... (but to) choose appropriate policies by making possible the exploration of the implications of alternative actions" (WMO, 1980). The foci are "What If" questions. We are not constrained by modelled "facts" but we can consider extended sets of data not now available. We can consider the implication of the extreme yet rare event. We can consider the socio-economic links. We can intellectually test several internally consistent yet externally conflicting results in terms of what is reasonable given a collective wisdom. Crucial questions may be asked, such as "What actions, taken when, would help to maximize opportunities and minimize the dangers implicit in the CO_2 (or other) issues?" (Clark *et al.*, 1982). In the absence of an adequate theory of climate for prediction, this may be the most progressive vehicle.

In addition to the development of a sufficient and confident mesoscale climatic database and method for analysis of hemispheric scale processes, we must also devote some effort to an understanding of local processes. The significance of this large scale climate interaction in the Arctic is illustrated by the estimate of heat loss through small open water leads, polynyas and young ice which can be an order of magnitude greater than that for the multiyear ice (Maykut, 1978). Even though the areal fraction of young ice is small (5 to 10 per cent), the associated energy flux into the atmosphere exceeds that from the balance of thick ice (Mueller, 1976; Mueller *et al.*, 1976).

Parallels exist on land. On the North Slope of Alaska, the surprisingly rapid spring melt of regional snow cover can be attributed not to the expected large scale advection of warm air, although this is the initial trigger, but to local scale advention of air warmed over knolls or tufts of high vegetation blown free of snow. These knolls therefore have much greater absorbed insolation than the surrounding snow covered tundra and act as thermal nuclei for the regional melt (Weller *et al.*, 1972).

A large scale climate anomaly on Truelove Lowland of Devon Island is identified as a "thermal oasis," (Courtin and Labine, 1977). This is attributed to the dissipation of the normal arctic cloud decks by adiabatic warming of winds from the Devon Island Icecap as well as solar warming of a west facing granite outcrop. This warming influences animal activity such as calving and contributes to the diversity of the ecosystem (Bliss, 1977).

The identification and study of a cross section of the many regional climatic anomalies is the first step towards conservation of the unique gene pool of the Arctic (Sage, 1981). The diversity in the oases is insurance against extinction under stress (Thomas, this volume). These regions also serve as benchmarks for assessing biotic response to variability and change. Ford (1982) considers such refugia to be the only true indicators of natural variation in the environment and suggests that biomes in climatically optimal habitats be preserved.

Such a view is in accord with policy statements by Environment Canada which will "..promote the establishment of a comprehensive network of protected areas in the North to provide adequate protection and management for areas and sites of significance in the preservation of Canada's natural or cultural heritage..." (Environment Canada, 1977). Of particular concern is the protection of certain Arctic "oases" where biological conditions favour unusually high wildlife concentrations (*Ibid.*).

Conclusions

In this review, I have illustrated the severity of climate variation and change on the arctic ecosystem; outlined our present knowledge of climate sensitivity in the Arctic; discussed potential points of human intervention, both advertent and inadvertent, that may affect future climate states; and have identified related research themes in arctic climate research.

The sensitivity of the arctic climate to natural and anthropogenic perturbations is a recently defined concept which has crucial implications for the immediate development and use of Canada's North.

In order that we can make informed decisions regarding our Arctic Heritage, several questions must be addressed:

1. What is a tolerable range in the climate variation before it is viewed as a hazard to the natural ecosystems, to Canada as a society and economic structure, and to the global community?

2. What is the expected disruption caused by our impacts? A caveat is our limited understanding of climate processes and their linkages to other sciences.

3. What are the minimal impact alternatives that we may realistically consider?

4. Are there mitigating actions that may be adopted? Here I caution that in a complex and highly non-linear system such as the climate system there is no such thing as an isolated fix. There will be unknown ramifications.

The significance of these questions is focused when the principles of climate variability and change cited in the introduction are borne in mind; most notably "...the potential for geopolitical disorganization and conflict is great."

Successful answers are contingent upon certain assumptions. The most important is that we have a knowledge of arctic climate processes that is equivalent to that of our knowledge of mid-latitude systems. This is not true. We have a great deal to learn.

Another assumption is that we have operational linkages between climatologists and ecologists, sociologists and economists. The former linkage is well established, but the latter two have been slow coming because of the external observer's view that climate is inherently unpredictable (Hare, 1979). However, Hare (*Ibid*) attempts to put this in perspective by wondering: "whether the high reputation of the medical profession would survive the requirement that they broadcast their prognosis within a few hours of seeing their patients!"

A third assumption is that we recognize that judgement has a major role in the interpretation of our results. There are significant error envelopes around our data, the mathematical simulations and our evaluations. An understanding of these error envelopes is the basis for development of alternative scenarios and informed application.

We are on the verge of exciting research opportunities in Arctic climatology that will be of considerable benefit to those responsible for management of our northern resources. The turning point has been the recent increased accessibility to the region through remotely sensed imagery. Furthermore, our programs of detailed field measurement have reached a critical mass. We are now starting to understand the nature of the interrelationships between the cryosphere, atmosphere and ocean and the spatial dimensions of those interrelationships. With continued examination, we will understand the temporal characteristics of variability and change and will be able to develop forecast scenarios of interest to policy analysts.

Summary

Arctic regions are particularly vulnerable to climatic variability and change. This has important implications for the management of natural resources and the development of man's habitation in Canadian North.

As a consequence of the nature of the feedbacks between the cryosphere the atmosphere and the ocean, the climate is significantly more sensitive in the Arctic than elsewhere to any perturbations within the climatic system. Scenarios are being developed on the basis of numerical simulations of the atmosphere and the study of past climates as analogues in an effort to understand the nature of the variability or change and to give insight into the probable consequences. Essential variables involved in these feedbacks include the CO_2 and particulate loading of the atmosphere, the extent of the pack ice, deforestation of the Boreal forest and the general circulation of the atmosphere and ocean.

In this paper, the factors contributing to the sensitivity of the arctic climate to variability and change have been reviewed. The directions of research required to provide more confident answers to questions related to planning in the Canadian Arctic have been discussed. Of particular concern is the dearth of traditional data with sufficient temporal and spatial resolution. Hemispheric surveillance using repetitive remote sensing is necessary to examine regional scale processess. Intensive study is proposed of key ecological areas such as refugia and thermal oases as well as anomalous phenomena such as the North Water.

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Marine Processes

J.M. Baker and M.V. Angel

Introduction

The Arctic Ocean is a large Mediterranean-type sea which is almost entirely surrounded by land at latitudes of 70-80° N. It opens into the other oceans via the Bering and Fram Straits. The Bering Strait which opens into the North Pacific is only 70 kilometres wide and its sill depth is but 70 metres. The Fram Strait between Greenland and Spitzbergen opens into the North Atlantic and is 400 kilometres wide and has a sill depth of 400 metres. The Arctic continental shelves are broad and shallow in marked contrast to the narrow Antarctic shelves which are depressed isostatically by the massive weight of continental ice. In the Barents Sea the shelf reaches a maximum width of 1300 kilometres and 53 per cent of the Arctic Ocean is occupied by water of shelf depth. Even in the deeper areas the bottom topography is complex with systems of ridges, notably the Lomonosov and Mendeleev Ridges, dividing it up into a number of deep water basins.

Within the Arctic Ocean are many potential hydrocarbon basins (Figure 1) and petroleum exploration and development is proceeding rapidly in the ice-covered waters of the Arctic continental shelves. Oil and gas reservoirs have been discovered in the Beaufort Sea and Sverdrup Basin; and exploratory activity is taking place east of Baffin Island; in Arctic Norway (Gjester, 1983), and the Barents Sea (Anon, 1984, 1985). The risks of accidents due to environmental hazards are particularly high and the likelihood of oil being spilt in the Arctic has increased dramatically. This appears to be the most immediate serious threat to Arctic ecosystems. The widespread perception of this threat has led to a great deal of activity including environmental impact assessments, the development of oil spill countermeasures in icy waters, toxicity tests on Arctic species, and multidisciplinary field oiling experiments on Baffin Island.

Consideration of the possible effects of oil industry activities runs through our review of Arctic marine processes.

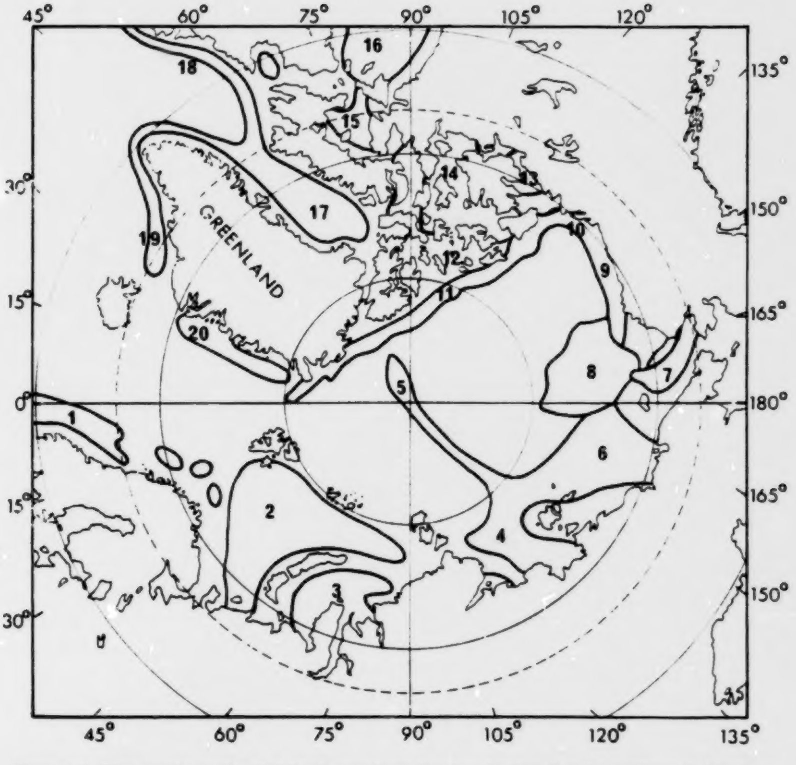

Figure 1 The main potential hydrocarbon basins in the Arctic region: 1. Voring; 2. Barents Sea; 3. Kara Sea; 4. Laptev Sea; 5. Lomonosov Ridge; 6. East Siberian Sea; 7. Hope; 8. Chukchi; 9. Beaufort Shelf and North Slope; 10. Mackenzie Delta; 11. North Arctic Shelf; 12. Sverdrup; 13. Wollaston; 14. Victoria Strait; 15. Foxe; 16. Hudson Bay; 17. Baffin Bay; 18. Labrador Shelf; 19. Southwest Greenland Shelf; 20. East Greenland Shelf.

Hydrological Processes

The bathymetry of the Arctic prevents much deep-water exchange with other oceans. Even the surface drift is far more topographically controlled than is usual partly because of the decoupling of the sea surface from the wind system by the ice cover and partly because of the influence of the substantial freshwater inflows. The Beaufort Gyre, a massive clockwise eddy about 100 kilometres in diameter, dominates the Canadian sector (Figure 2). Beyond it is the Transpolar Current which flows from the Bering Strait towards the Fram Strait. Its speed is generally $< 10\text{-}15\ \mathrm{cm.s^{-1}}$ but it can reach speeds of $30\text{-}50\ \mathrm{cm.s^{-1}}$ (Aagaard and Coachman, 1977). It feeds into the East Greenland Current which flows out through the Fram Strait and down the coast of Greenland to eventually form the Labrador Current. In the Russian sector the various island arcs induce the formation of a number of small current gyres over the shelf. In general the pack ice drift follows these patterns of the general set of the surface currents, bergs drogued in deeper water often move across the direction of the surface drift.

The cold water outflow is predominantly balanced by two oceanic warm water inputs. A small inflow enters from the Pacific via the Bering Strait. Its influence can be traced in the Transpolar Current by both hydrographic and planktonic indicators as far as the Pole. The major warm water inflow is from the Atlantic via the Spitzbergen Current which flows up from the western Norwegian coast to the south and west of Spitzbergen. This keeps this region ice free far more to the north than elsewhere (Figure 2). The boundary between the warm inflow and cold outflow forms the Polar Front. This front lies well north of 70° off Norway, intercepts Iceland on the edge of the Arctic Circle and extends as far as 58° N which is south of Greenland. In the Bering Sea the Polar Front lies more latitudinally, but extends southwards down the eastern seaboard of Kamchatka. This front is a major biological influence and determines the distributional limits of many species of pelagic organisms. Another important feature of the front is that it has been greatly influenced by climate. In 1985, at the height of the mini ice age, Iceland was surrounded by sea ice for the whole year (Lamb, 1977). The CLIMAP experiment (Cline and Hays, 1976) provided evidence that 15,000 BP the front lay at about 45° in the north Atlantic, and ice rafted debris has been identified in superficial sediments as far south as 38° N. Did any marine fauna survive in the 100 per cent ice covered Arctic Region during this glaciation except in isolated refuges?

The position of the edge of the permanent pack is another important factor. Generally, it lies parallel to the Polar Front, extending south to 70° N in the East Greenland Current, but well beyond 80° to the north of Spitzbergen. It briefly intercepts the Russian mainland at 100° E, but

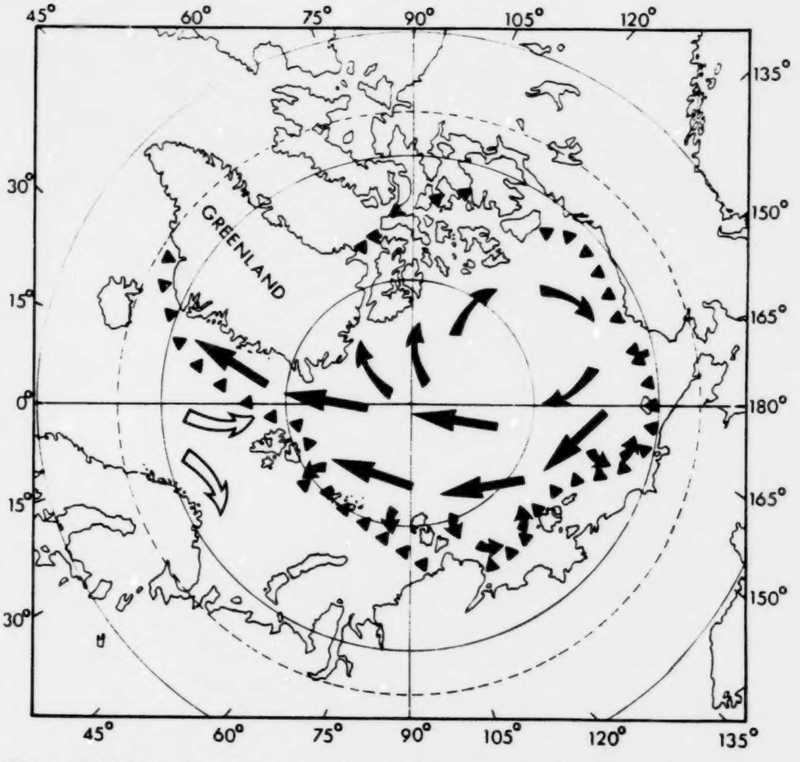

Figure 2 Main surface current system and the approximate edge of the permanent pack-ice (after Hempel, 1985).

most of the Siberian coastline is ice-free in summer as a result of the freshwater outflow of the major rivers. In the Alaskan and Canadian region the edge of the permanent ice pack lies just clear of the coastline at 71-72° N.

There is relatively little seasonal reduction in the area of pack ice in the Arctic (10 per cent) compared with the Antarctic (70-80 per cent). Only in the Bering and Greenland Seas and a few of the shelf areas are there major shifts in the edge of the park ice. Arctic pack ice is multiyear old, up to 3-5 metres in thickness and crumpled into such complex ridges that human access is difficult. The older ice especially when snow covered is thick enough and opaque enough to absorb most of the light, so the development if an ice flora may be minimal except in the relatively small areas where the ice is annual (Apollonio, 1965; Horner, 1977).

Between the pack ice and the shore two zones may be distinguished. The bottom-fast ice zone occurs just offshore in areas where the underformed sea ice is thick enough to freeze to the bottom (usually in water depth of less than 2 metres). The floating fast ice zone occurs just offshore from the bottom-fast ice and extends seawards for varying distances depending upon the time of year. Large movements of ice are presumed to be possible in this zone (Weller, 1980).

The freshwater inputs from the MacKenzie and great Siberian rivers have a major influence on the region's hydrography, although the riverine inputs are small, 0.1-0.13 Sverdrups (1 Sverdrup=$10^6 m^3 s^{-1)},$ relative to the oceanic inputs of 4.0-6.5 Sverdrups (Treshnikov, 1977). Typically the surface 50-70 metres of the water column has a relatively uniform temperature (-1.8° C) and salinity (29.5 x $10^{-3)}$ Central Arctic water is of lower salinity than the water overlying the Siberian continental shelf, freshened by water from the Beaufort Sea. In the Beaufort Sea there is a temperature maximum at 75 metres produced by the inflow of Pacific water through the Bering Strait, and its influence can be traced as far as the Pole both hydrographically and through the biological indicators, the copepods *Calanus tonsus, C. cristatus* and *Eucalanus bungii*. Below the Pacific Water lies the Atlantic water, the boundary being marked by an oxygen minimum at 150 metres and a temperature minimum (-1.490C) at 150-200 metres. At 250-900 metres in the Beaufort Sea is Arctic Intermediate Water (AIW) and below that is Arctic Bottom Water which in the main Eurasian Basin has a salinity of 34.94-35.00 x $10^{-3,}$ a temperature of -0.8° C and an oxygen content of 72-78 per cent. In the American basin the salinities are similar but water temperatures are 0.4° C cooler and oxygen levels are slightly higher at 79-82 per cent.

Throughout most of the Arctic tidal cycles are semidiurnal, but around some of the Soviet Islands, along much of the north Alaskan coast, the Baffin Bay region of the west coast of Greenland and in Lancaster Sound there is an irregular semidiurnal cycle. Similarly tidal ranges are less than a metre except in the White Sea and the adjoining Norwegian coast and in the Davis Strait, Baffin Bay and in many sounds and straits of the Canadian Arctic Islands. During periods of strong wind, high storm surges (Owens, 1977; Weller, 1980) may lead to seawater moving considerable distances inland along low-lying coasts.

What are the implications of these hydrological processes in connection with oil industry developments? First, of course, sea ice is the major hazard tackled during drilling operations. Where ice motion is negligible grounded barges or artificial ice islands are cost-effective platforms for exploratory drilling. Man-made gravel islands and causeways tend to stabilize nearby ice cover so are rather less susceptible to lateral ice movements. Any structures contemplated for the pack ice zone would have to be designed to withstand the force exerted by moving masses of thick first-year ice and by large multi-year flows with embedded pressure ridges. As sea ice moves over the continental shelves, the keels of pressure ridges gouge the bottom, presenting a serious hazard to wellheads and buried pipelines in the pack ice and fast ice zones (Weller, 1980).

Questions with conservation implications are:

1. Does the limited water exchange with other oceans mean that there will be a build-up of oil residues in the Arctic?

2. How does spilt oil interact with ice?

3. How far may oil entrapped in ice be transported?

4. What spill clean-up measures are effective in icy waters?

5. Could high storm surges strand oil on sensitive coastal waters?

Sediment Processes

The bottom sediments are predominantly fine and course silts of terrigenous origin transported in by the rivers. They are well oxidized and appear to be subject to very little diagenesis, probably because of their low organic content and the low water temperatures. Off Franz-Joseph Land, Golikow and Averincev (1977) found clear water overlying muddy sediment with sea-ice scour marks at depths of 2-3 metres and berg plough marks at the depth of 20 metres. In contrast around the New Siberian Islands the waters were turbid with riverine salt kept in suspension by the tidal mixing and the sea bed was stony or even scoured down to bedrock. Carey and Ruff (1977) found similar well-oxidized, organic-poor muddy sediments in the Beaufort Sea, but reported some areas of sand inshore and gravel at the shelf break. Sedimentation rates in the deep water basins are at most 1.5 centimetres/1000 years (Gorshkov, 1983).

The dominant process affecting nearshore sediments is moving ice, gouging and scraping the bottom resulting in considerable sediment disturbance (McLaren *et al.*, 1981). In recent years disturbance must have considerably increased in some oil exploration areas because of dredging operations. Dredgers have been used in the Beaufort Sea for the construction of caisson retained islands (CRIs). Caissons are designed to be placed on sub-sea berms and form a containing wall for a sediment core through the wave zone. Gas discoveries at Kadluk (in 20 metres of water) and Amerk (in 26 metres of water) have resulted from the use of this method and it is now possible to dredge soft to stiff clays in water depths as great as 42 metres. Depending upon future developments, there may be requirements for pipeline trenches and other excavation to protect sub-sea equipment from ice-scour.

Another sediment process depending upon human activity is the shifting of gravel from the shore to form gravel islands, the largest of which to date are Seal in 10.7 metres of water and Mukluk in 14.6 metres of water. Since the quantity of gravel required for an island increases exponentially with water depth, the technique usually becomes uneconomical for water depths greater than 15-20 metres. Typically, the gravel is mined on-shore and trucked during the winter over ice to the construction site.

Under natural conditions, the redistribution of shore zone sediments takes place primarily during periods of storm wave activity. Owens (1985) has described shoreline changes on the barrier beaches and barrier islands of the Beaufort Sea coast. Individual storm events have been known to produce local erosion rates of tundra cliffs up to 13 metres over only a few days. Even though mechanical wave energy levels are generally low (because sea ice effectively reduces fetch) the barrier systems are unstable. On the Alaskan coast there is an average landward movement between 3 and 5 metres per year, and a westerly migration of 20-30 metres per year (Owens, 1985).

Ice action as well as wave action may move shore sediments into nearshore waters, and ice floes with a sediment layer on top have been observed stranded on the edge of a Baffin Island beach (Dickens, 1981).

It can be seen that one aspect of exploration for oil is man's active engagement in sediment processes. What are the conservation implications? Other questions also arise:

1. How does spilt oil interact with inter-tidal and sub-tidal sediments?

2. Can oil movements on beaches be predicted?

3. What spill cleanup measures are appropriate for Arctic beaches?

Nutrient Cycling

The major input of water into the Arctic is the near-surface flow from the Northeast Atlantic. During summer this water has had much of the nutrients stripped out of it, and even in winter when deep convective mixing has increased, its nutrient content is still low relative to the Pacific input. For example, phosphates are <0.75 g.l^{-1} even in winter in the Atlantic inflow but are >1.5 g.l^{-1} in the Pacific inflow. Silicate concentrations are similarly enhanced in the Pacific inflow and also in the vicinities of the major river estuaries.

In addition to the major source water for the Arctic being relatively impoverished in its nutrient supply, the general stable density structure of the water column and inhibition of wind mixing of the surface layers by the extensive ice cover, all contribute to nutrient concentrations being comparatively low in Arctic euphotic zones. Ice melt provides some input since nutrients get incorporated into the sea as it forms; Grainger (1977) observed the levels of phosphate in one-year ice increasing from 0.35mg-at.m^{-2} in January to a maximum of 0.63 in March, and then decreasing to 0.57 in late May to nothing in July. Maximum nitrate levels were 3.3 mg-at.m^{-2}, and enrichment can occur in brine pockets within the ice.

Nitrate is rapidly exhausted as algal production increases during the spring, and is normally the limiting nutrient.

There is evidence that although pack ice moves with the surface drift, icebergs moving according to deeper currents which may be in quite different directions, leave a wake enriched with nutrients stirred up from below the pycnocline. The disturbance of bottom sediments by ice may also lead to local nutrient enrichment.

Possible sources of local enrichment connected with human activities are:

1. Dredging and other sediment disturbance.

2. Sewage effluents from vessels and drilling rigs.

3. Spent drilling fluids. Common drilling fluid components listed by Gettleson (1980) include compounds containing phosphorus and sulphur.

4. Degraded oil from spills. As well as hydrocarbons, oil contains complex organic compounds containing nitrogen and sulphur.

The importance to conservation interests of these human activities is not known but is probably rather small. A more important concern is whether the low nutrient levels are a limiting factor for the natural microbial degradation of spilt oil, and hence whether biodegradation can be effectively enhanced using fertilization techniques.

Energy Flow

The primary producers in Arctic Waters are phytoplankton, ice algae, benthic algae in the inter-tidal and shallow sub-tidal zones, and coastal marsh vegetation periodically inundated by tides or storm surges.

When the day length becomes sufficiently long in the spring, there is a short period of high phytoplankton productivity before the available nutrients are used up. Ice may have an influence on this production, because in shallow waters it can reduce tidal mixing so that less phytoplankton is churned down below the limits of the euphotic zone. Also, production levels are based to some extent on nutrients leaching out of the ice (Slagstad, 1985). Over deeper water as the melting ice stabilizes the water column, the bloom is initiated at the halocline where the brackish water interacts with the deeper nutrient-rich (relatively) inflow water. Under these conditions, high production may persist for as long as two to three months in the Barents Sea, where Rey and Loeng (1985) described how the zone of productivity moves northwards with the ice edge as the summer progresses.

The pattern of distribution of zooplankton biomass (Figure 3) in general reflects the levels of primary production. The very short production season and the low levels of food available during the rest of the year favour a range of adaptations in the herbivores (Dunbar, 1970). Rapid growth is restricted to the short season of phytoplankton abundance, and many species undertake seasonal migrations into deeper water and enter a state of diapause during the rest of the year. Annual life cycles are uncommon, the majority of planktonic species have two or three year life cycles. Adult body size tends to be large which seems to be associated with better survival during the long periods of food shortage, and both high fecundity and larger egg size. Plankton communities in these conditions are poor in species, and omnivores and feeders are more abundant.

The ice algae make a major contribution to the annual production level. These algal communities are usually dominated by pennate diatoms (Cross and Martin, 1983), and form a dense growth on and in the soft bottom layer of sea ice. Its production has been estimated to provide between 6 and 33 per cent of the total annual primary production in various Arctic locations (see Cross, 1982). In addition it is important because ice algal growth occurs before there is significant production by either planktonic or benthic algae during the open water season.

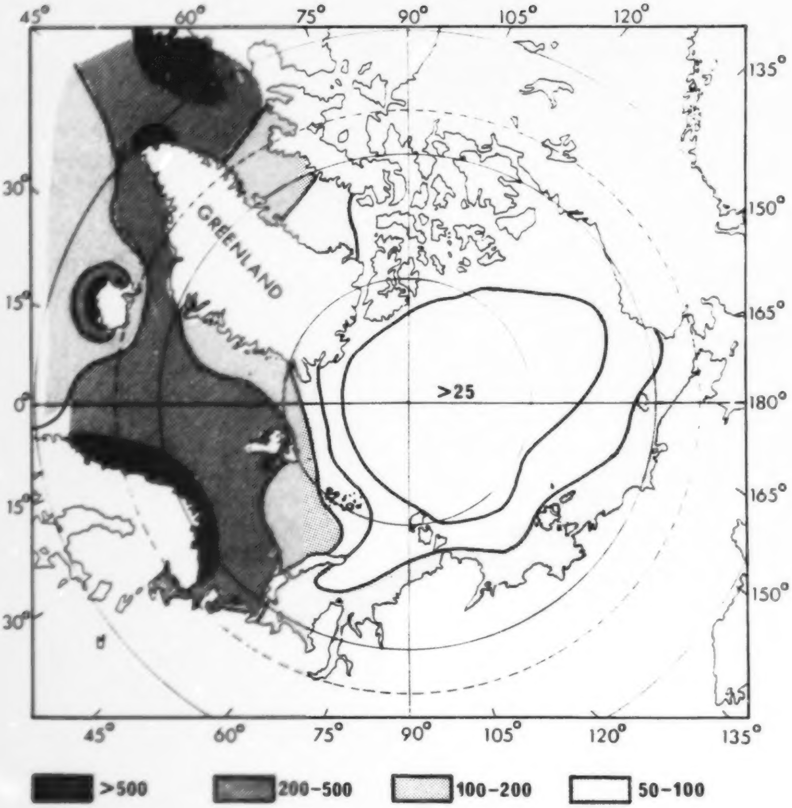

Figure 3 Distribution of the mean values of zooplankton biomass in the top 100m in mg/m^3 (after Gorshkov, 1983).

Food chains leading from ice algae have been described by Nelson-Smith (1982). The algae are grazed by small invertebrates, notably amphipods, which are an important link in Arctic food-webs. Cross (1982) found that of the ten species of gammarid amphipod on the under-ice surface at Cape Hatt, Baffin Island, just three accounted for 86 per cent of the total amphipod biomass.

The browsing invertebrates in turn attract fish and marine mammals and along the ice edges seabirds in large numbers. The most abundant fish in Canadian waters is the Arctic cod, although it is not so numerous off western Siberia (Nelson-Smith, 1982). It matures in 5 years and probably spawns only once in its lifetime. The Arctic char is even slower growing, reaching maturity after 14 years.

About 6,000,000 seabirds breed in Arctic Canada, migrating there from about one third of the earth's surface. Many of these also mature late and breed at a slow rate (Nelson-Smith, 1982). Large bird colonies are scattered throughout the Canadian Arctic archipelago.

Marine mammals (polar bears, seals, walruses and whales) form a group in which, atypically, diversity is greater in the Arctic than in many other regions. Most are widely scattered for much of the year but at times seals and bears are concentrated for breeding or feeding, and whales follow defined migration routes. Faunal differences are found between provinces, for example in the two subspecies of walrus (*Odobenus rosmarus*) (Figure 4) and the various races of ring seal (*Pusa hispida*). These differences probably have their origins in the influence of the recent glaciations when the faunal elements were isolated in different refugia for long enough to differentiate but not to speciate.

Phytoplankton and ice algae are the main primary producers but there are others in the coastal zone. Ice scouring means that the inter-tidal and shallow sub-tidal zones cannot support the dense growths of attached macroalgae that are found in temperate areas; however rapidly growing annuals, or species which can regenerate quickly from basal stumps, are found. These may be grazed in situ or may contribute to detritus in the coastal water. Salt marsh plants are another source of detritus, possibly important locally in areas such as the Mackenzie delta. Productivity is however, very low. MacDonald (1977) gives figures of 0.02-0.24 kilograms (dry weight) $m^{-2}yr^{-1}$ for *Carex ramenskii* and 0.05-0.14 kilograms $m^{-2}yr^{-1}$ for *Puccinellia phryganpodes*, rates which are about a tenth of those observed in temperature marshes. However, growth is more vigorous where plants are partly covered by decaying algal mats, suggesting that nutrients are normally limiting (MacDonald, 1977).

Detritus both from coastal sources and from dead phytoplankton, ice algae and invertebrates tends to sink to the bottom sediments, where it supports communities of benthic invertebrates. Below the energetic shallow zone and ice plough depths (where opportunistic species would be fav-

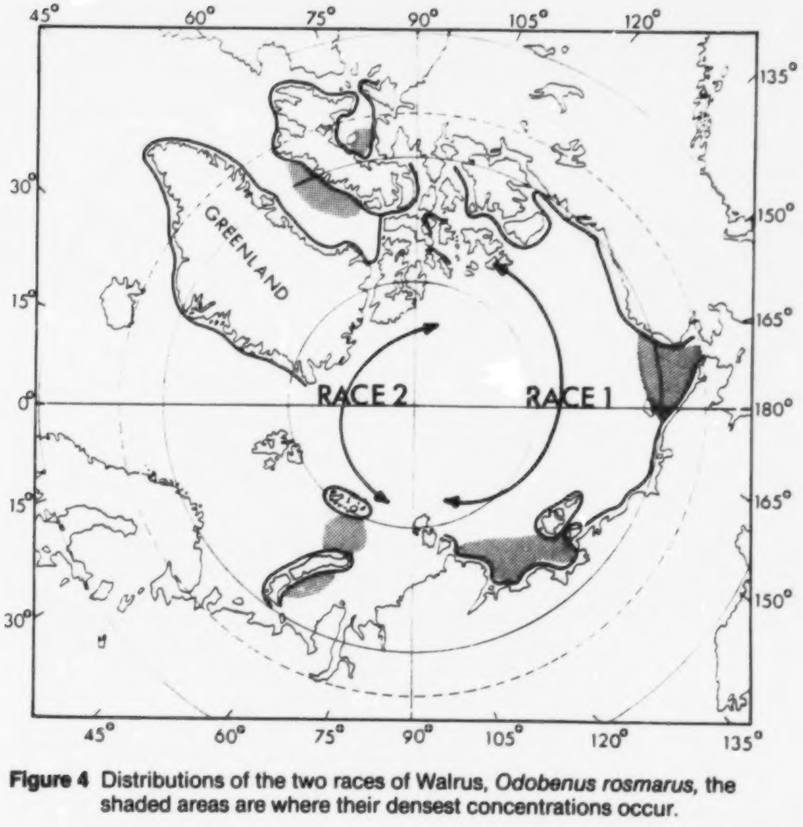

Figure 4 Distributions of the two races of Walrus, *Odobenus rosmarus*, the shaded areas are where their densest concentrations occur.

oured), the benthic communities reflect the sediment type. They are dominated by filter and seston feeders. Populations are typically sparse, species rich, and composed of relatively large individuals (Golikov and Averincev, 1977). Molluscs tend to be the dominant macrobenthos (60-80 per cent). Standing crops reflect levels of primary production. In the Beaufort Sea, inshore the standing crop was 10-60 $g.m^{-2}$, 40-225 $g.m^{-2}$ at the shelf break and 4 $g.m^{-2}$ in deep water (Carey and Ruff, 1977). Knox and Lowry (1977) reported literature values about three times larger from the East Bering Sea, twice as large from the Barents Sea, but only half from the Kora Sea (Figure 5).

Zenkevitch (1963) proposed a broad zoogeographical zonation for Arctic benthos which is still generally accepted. The abyssal Arctic subregion includes not only the two deepwater basins of the central Arctic but also the Norwegian Sea basin. The shallow lower Arctic subregion underlies the warm water inflow from the Atlantic in the Barents and White Seas. The shallow high Arctic subregion is subdivided into the Siberian and North American-Greenland provinces, each of which is further subdivided into an inshore brackish, and an offshore fully marine realm. There are faunal differences between these provinces, as with other animal groups such as the mammals mentioned above.

Some general characteristics of Arctic energy flow emerge (Dunbar, 1970). There are few species, so food chains tends to be short and simple. Mean productivity and biomass tend to be low (with nutrients being a limiting factor), but there are very large seasonal fluctuations. Such simple systems tend to be unstable and are subject to large population oscillations. Dunbar (1970) suggested that greater ecological stability is achieved by, among other things, increasing the species diversity and spreading the feeding load over longer periods. This could, for example, be achieved by herbivores becoming partly omnivorous and eating detritus and microzooplankton. In the evolutionary context the interest lies in the possible differentiation of morphological pattern and food habit within species, and Dunbar (1970) points to species complexes of *Gammarus* and *Calanus* as examples of evidence of recent evolutionary divergence.

How may oil industry developments affect productivity and food chains? It seems likely that spilt oil could become trapped under ice, and in the spring this would subject primary producers to greater concentrations of oil for longer periods of time than is the case following temperate oil spills. Other questions are:

1. Are there any "weak links in the chain"-species which are particularly sensitive to oil?

2. Might there be sub-lethal effects (e.g. on photosynthesis, feeding or breeding behaviour) which would reduce productivity?

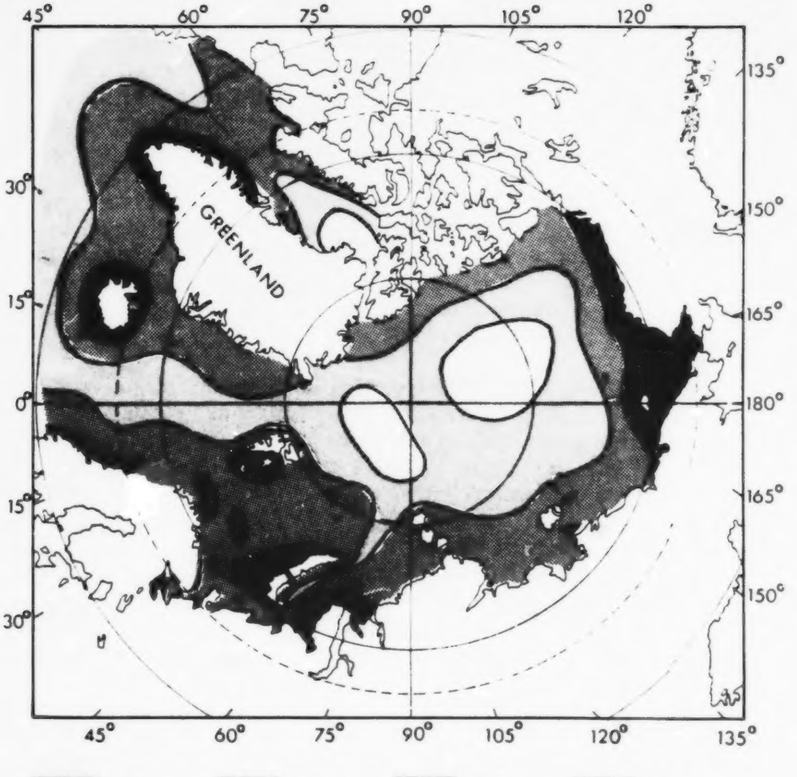

Figure 5 Distribution of benthic biomass in g m^{-2} (after Gorshkov, 1983).

Pollutants Effects, Pathways and Sinks

Accidentally spilt oil is the most obvious pollutant associated with oil industry activity; however there may also be operational discharges. The most significant of these in the Arctic at present are spent drilling fluids which, after treatment, are discharged under the ice (Friesen, 1980). It is also necessary to consider the effects of dispersants which are a potential clean-up option for some spills. The toxicity and physical effects of oil, drilling fluids and dispersants have to some extent been investigated for Arctic marine organisms, and lethal and sublethal effects reported (Table 1). Severe toxic effects are particularly associated with low boiling and aromatic hydrocarbons.

Physical and chemical changes in oil discharged into northern seas are summarized by MacKay (1985). Briefly, the oil is redistributed by the physical processes of spreading, evaporation dispersion, solution, adsorption and sinking. Degradation occurs through chemical oxidation (especially under the influence of ultraviolet light) and by biological processes. Particular considerations in the Arctic are:

1. Crude oil achieves a relatively thick equilibrium layer on water or ice, and the lighter, more toxic, more inflammable components are retained for longer than in temperate regions. Thus there is greater potential both for severe localized toxic effects and for the use of burning as a clean-up technique.

2. Oil may become frozen in slush, or trapped under or encapsulated in solid ice. All these fates will enhance retention of the lighter components mentioned above.

3. When trapped in ice, oil may be transported as a result of ice movements.

4. Oil reaching beaches can be buried, eroded or transported depending upon beach dynamics. Oil penetration into sediments may be limited by ice within the beach. Oil can be incorporated into an ice form at the formation stage, and be released during the melt season.

5. Unfortunate combinations of circumstances could lead to oil being carried far inland by storm surges.

6. Degradation of oil by photochemical oxidation will be extremely long for long periods of the year.

Table 1: Some effects of oil industry pollutants on Arctic marine organisms

Organisms	Effects	Reference
Bacteria (Baffin Island BIOS experiment)	Not deleteriously affected by crude oil but decreases in activity with addition of a dispersant.	Bunch *et al.*, 1982
Ice algae (Baffin Island BIOS experiment)	Productivity suppressed by high levels of oil and dispersed oil (10,000 ppm). Possible stimulation effects with some oil treatments.	Cross, 1982 Cross and Martin, 1983
Under-ice amphipods (Baffin Island BIOS experiment)	High mortalities following exposure to oil masses; dispersed oil had less effect.	Cross 1982; Cross and Martin, 1983
Amphipods (Prudhoe Bay	Increase in total metals concentrations when exposed to various drilling fluid concentrations.	Tornberg *et al.*, 1980
Fish	Oil spills can cause fish kills in restricted waters, and under laboratory conditions exposure to low levels of petroleum hydrocarbons can affect egg hatching and larval development.	Literature summarized in Baker, 1983
Fish (Prudhoe Bay)	In tests with drilling fluids, were among the most sensitive organisms tested.	Tornberg *et al.*, 1980
Birds	Most oiled seabirds die.	Literature summarized in Baker, 1983
Mammals	Harmful effects of oil have been reported for seals, otters and polar bears. Toxic effects and in some cases death in the case of polar bears attempting to lick heavy oil deposits from fur.	Engelhardt, 1981 and other literature summarized in Baker, 1983

For comprehensive general reviews of hydrocarbon effects on Arctic microorganisms, invertebrates, fish, birds and mammals see Engelhardt (1985).

7. Low nutrient levels will limit the activity of oil degrading bacteria. This has been demonstrated in the BIOS experimental program on Baffin Island by Eimhjellin *et al.*, 1983-fertilized oiled plots are developed much greater populations of oil degrading bacteria than oiled plots not receiving fertilizer treatment.

From the conservation point of view, the most acceptable fare for spilt oil is for it to be contained close to the spill source and disposed of, e.g. by burning. Containment of source is included in industrial site planning, but this option has to be be abandoned if it creates unacceptable risks to human safety such as a threat of uncontrollable fire. A number of options for containment and for cleanup if the oil escapes into the wider environment, are listed in Table 2.

Guidelines are now being developed for spill-response coordinators. For example the Field Guide for Arctic Oil Spill Behaviour described by Schulze and Lissauer (1985) was developed to provide the coordinator with "the spill behaviour information needed ro ensure timely and adequate containment and removal. The guide describes Arctic ice conditions, the physical properties of oil as it weathers, oil spill behaviour in cold water and ice conditions, and spill retention potential for the Alaskan shoreline. Six spill scenarios show the user how to apply spill behaviour information to solve actual problems." In connection with the prediction of oil movements on beaches, the work of McLaren (1984) is useful in that it is based on examination of beach sediment samples which can be collected relatively quickly and cheaply. Models deriving patterns of sediment transport, and hence oil transport, can be derived from the sediment characteristics.

There are three fates for the residue of oil components remaining after cleanup activities and/or natural transport, weathering and degradation processes:

1. Shore deposits in very sheltered areas or above high tide mark.

2. Small particles suspended for long periods of time in the water column.

3. In sediment "sinks" in the seabed.

Clark and Finley (1982) list and reference data on hydrocarbon levels in Arctic waters and sediments. These data, although very limited, indicate that during the 1970s the background level of petrogenic hydrocarbons were generally very low. It seems almost inevitable that widespread production and transport of oil in Arctic waters would lead to an increase in these background levels of oil residues.

Table 2: Containment and clean-up options for Arctic oil spills

Containment

- Ice slots and through-ice barriers
- Building of snow berms
- Formation of ice berms using pumped sea water
- Building of gravel berms

Physical Methods for Oil Clean-Up

- Ice breaking with explosives or vessels to expose oil
- Direct pumping of oil
- Absorption and removal with solvents or snow
- Scraping and removal of surface oil with heavy earth-moving equipment
- Use of rope mop skimmer beneath ice or among broken ice

Burning Methods

- Ignition of source
- Burning of oil in fireproof booms
- Release of ignitors into oil pools
- Induced migration and burning of subsurface or entrained oil
- Incineration of oil or oiled debris

Chemical Methods

- Dispersants
- Oil herding agents

Sources: Allen and Nelson, 1981; Boehm *et al.*, 1985; Hillman, 1985; Kretschmer and Odgers, 1985; Nelson and Allen, 1982; Shum and Borst, 1985.

The Future of the Arctic Ocean

The immediate future appears to be one of widespread exploration for oil and gas. It is less clear at present exactly where and how commercial production will develop. Nevertheless, it is obvious that routine oil industry activities constitute new types of disturbance to Arctic systems, namely concentrations and movements of men and heavy equipment, engineering works such as the construction of artificial islands, and discharges of materials such as drilling fluids. Additionally there is the threat of well blowouts and other accidents causing serious oil pollution.

Considerable research has already been done on spill behaviour, control and clean-up methods, but the need for such applied work continues. In particular, each development area has its own unique characteristics and requires tailor-made environmental protection and oil spill contingency plans.

The biological effects of oil spills appear to have been better researched than the effects of the routine disturbance resulting from industrial activities.

Management needs are at least as important as research needs in the short-term future. They include the organization and implementation of environmental protection measures and spill contingency plans, and the training and updating of the staff involved.

From a different and longer-term perspective, the Arctic marine ecosystem is relatively young in terms of geological time scales. Because of its geological structure and relationship with continental land masses, it is isolated and sensitive to climate change. Thus its environmental processes are probably still subject to evolutionary adaptation, and man-induced climatic changes offer the greatest overall threat to the present system as a whole. Perhaps the concern should be whether or not the suggested warming of global climate through elevation of atmospheric carbon dioxide levels is about to occur. There are still major uncertainties as to what the effects will be, but any reduction in ice cover of the Arctic will have a positive feed-back effect by reducing the Earth's albedo so that the warming is enhanced. Changes in ice coverage would have a major effect on Arctic ecology.

Similarly, any substantial alteration in the freshwater outflow, e.g. by reversing the flow of Siberian rivers, may have significant effects on ice formation, sedimentation patterns and the degree of vertical stability of the water column. The biological consequences of such changes are not intuitively obvious and need to be modelled.

River outflow is one major source of pollutants. Estuarine processes in which metals are precipitated are unlikely to be substantially affected by cold temperatures, but any processes dependent on biological activity will be much slower. Thus microbial breakdown of organics will be slower and removal of substances chelated into organics will be slow because of the apparent absence of any biogenic sedimentary flux. However, the low nutrient status of the total system will buffer it against the rapid eutrophication observed in the Baltic except locally in inlets, straits and fjords where water exchange is topographically restricted.

The maintenance of living resources and genetic diversity is posing a number of highly contentious problems giving rise to conflict between conservationists and exploiters. In the cases of the Bowhead whales and the various species of seals which are either exploited or culled to protect fishing interests, both sides are responsible for either ignoring or distorting the available, albeit inadequate, scientific evidence to serve their own ends. Unfortunately even for large obvious mammal species the errors of census estimations are so broad that the identical data are used to support the case both for a total ban on killing and for a heavy kill (or cull). Our understanding of the complex interactions between populations of different species within the same community is far too crude to provide a valid basis for rational management, as exemplified by the continuing problems facing fishery biologists of defending catch quotas against the industry's pressure to achieve short-term profitability.

Similarly the environmental consequences of the exploitation of nonliving resources tend not to be rationally analyzed. Repeatedly the gloomy predictions of the environmentalist can not be (or are not) seen to be fulfilled against the background noise of environmental variability, devaluing their judgements in future cases. Value judgements always have to be made, but the confusion between knowledge and ignorance, dogma, hypothesis and theory in the application of environmental science is counter-productive. There is a clear and urgent need for a rational conservation strategy for the Arctic region as a whole which is set in the proper context of a global strategy.

Appendix

Comparison of the Polar Oceans

This appendix summarizes the discussions in two important papers, Knox and Lowry (1977) and Hempel (1985). There are surprisingly few features in common between the Polar oceans. They both have cold waters with little seasonal variations, pronounced seasonality in the light/dark cycle and in ice cover. The Southern Ocean is an oceanic ring surrounding a central land mass with free access to the major oceans, whereas the Arctic is a more or less enclosed ocean with limited connection to other oceans. Currents are continuous Circumpolar in the South and Transpolar in the

North. There is no riverine input in the South so the sediments are poorly- sorted deposits of glacial origin and the water column lacks vertical stability. The large river input in the Arctic provides the main source of sediment and creates a highly stable density stratification of the water column. Nutrients are probably rarely limiting in the euphotic zone of the Southern Ocean but are seasonally limiting in the Arctic, consequently productivity is relatively lower in the latter. Pack ice cover is annually much more variable in the Southern Ocean than in the Arctic. Ice cover in the Southern Ocean has persisted over the last 14 million years, but only 3 million in the Arctic (Shackleton, 1982).

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Arctic Landforms: The Formative Processes

J. Brian Bird

The Arctic is a vast area. Circumpolar in distribution and reaching as far south as 53° N in James Bay, the land area exceeds 8 million square kilometres and the polar seas a further 14 million square kilometres. Within this immense region there is a great variety of physical landscapes: alpine mountain peaks partially covered by glaciers exceed 2600 metres in Ellesmere Island and nearly 2000 metres in Peary Land, elsewhere ice caps including the Greenland Inland Ice Sheet and the Northern Novaya Zemlya ice cap submerge the underlying topography, whilst at the other extreme of relief are the flat lowlands of western Siberia.

Early this century geomorphologists recognized that polar landscapes exhibit special elements that differentiate them from other landform regions of the earth. These observations have been developed, especially by Cailleux and Tricart and Cailleux (1967), and in Germany by Budel (1982), into the concepts of periglacial and, where there is permanent ice, glacial morphoclimatological regions. In them, climatically-constrained geomorphic processes are identified that produce unique landforms. Whether or not these models will prove the most valuable for cold region studies, particularly of an applied nature, continues to be debated, but it should be recognized that they apply essentially to micro-landforms, especially slopes. The larger, medium (meso)-scale landform units and the macro-scale units including physiographic provinces are essentially geologic units, and are not unique to the circumpolar lands.

The contemporary configuration of the arctic land masses evolved from the complex motion polewards and spreading apart of lithospheric plates in the late Mesozoic and Cainozoic. The Atlantic Ocean and its northern extension in the Norwejian Sea resulted from the separation of Scandinavia from Greenland and North America, with Baffin Bay and the Labrador Sea developing from the separation of Greenland and northeastern Canada. Many of the landform similarities of Labrador and coastal Scandinavia, so often emphasized by NORDEN geoscientists (Holtedahl, 1958) have their origin in these events. Seafloor spreading was associated with extrusive igneous activity. Hence the spectacular scenery of Iceland, an island, almost wholly igneous in origin, which throughout much of the Tertiary has lain at the crossroads of the north-south Atlantic mid-oceanic ridge and a zone of volcanic activity which touched Canada in Baffin Island, crossed middle Greenland and reached to Iceland and beyond.

On the other side of the pole, complex marginal plate activity was occurring in the Canada Basin (of the Arctic Ocean), the north Pacific, Alaska and Northeast Siberia where again vulcanism was also widespread and the larger continental units have close affinities.

One other comment should be made on landscape survivals from the past. Around the North Pole are located three pre-Cambrian Shields–the Canadian/Greenland, the Fennoscandia (or Baltic) and the Angara of northcentral Siberia. The rocks of the central core of all three shields are exposed at the surface, and the perimeters are covered on the continental sides by younger sedimentary rocks. About half the Canadian/Greenland Shield is located in the Arctic, a much smaller part of the Fennoscandian (albeit there is a great deal in the Subarctic) and none of the Angara Shield. Many of the landscape similarities of northeastern arctic Canada, Greenland and far northern Europe (but much less so of Siberia) result from their analogous positions in relation to the core-shield areas.

Whether the arctic mega-landforms are examined from tectonic-plate or shield-core viewpoints, we can identify an "Atlantic" shield-related group: northeast Canada, Greenland, the Atlantic arctic islands, northern Scandinavia and northern European Russia, including Novaya Zemlya, and the Pacific, fold-related "group", north-north central and north eastern arctic Siberia, arctic Alaska and the western Canadian arctic.

This aspect of arctic landscape presents it from an historical viewpoint, placing the mega-landforms in global, spatial and geological contexts. The approach from the opposite end of the time spectrum is to examine what is happening today, or putting it in a slightly different way, by the analysis of contemporary processes. These produce the short-term, usually micro-scale terrain features that are of special interest to the conservationist and to the engineer. It is on these that the remainder of the paper will concentrate.

The simplest geomorphological model is a system in which the initial element describes the metamorphism of the land surface (normally referred to as weathering), then the transportation of the modified earth material usually dominated by the action of gravity, and finally its deposition. In the arctic environment these three elements combine to produce landscapes with characteristics rarely found in other parts of the world.

Many of the early scientific descriptions of arctic landscapes emphasized the wastelands of shattered rock debris that are conspicuous in the terrains of Spitsbergen, Iceland and the eastern Canadian Arctic. The landscape of Helluland, the land of flat stones, described by the Vikings from Baffin Island in the eleventh century was surely of this type. It is usually assumed that freezing and thawing of moisture in the rock dominates the weathering processes but field data have failed to confirm a high frequency of frost-cycling and laboratory experiments have not been wholly successful in duplicating frost shattering of rock (McGreevy, 1981). Whatever the weathering processes may be, it is evident that rocks vary in the rate at which detritus is produced and in the particle shape and size (McGreevy and Whalley, 1985). Arctic plains and plateaus, which not infrequently are covered with rock debris, the felsenmeer, present numerous problems: their age of formation; to what extent they survive through glaciations, for there is no question but that they reappear from beneath retreating ice caps; the relationship of low-altitude felsenmeer to mountain top detritus: or indeed whether they originated under arctic conditions at all, or are more accurately described as pseudo felsenmeer (Bird, 1967).

The periglacial weathering processes are commonly active on steep slopes leading to vast accumulations of talus if the transporting agents (glaciers, rivers, sea) are unable to handle the debris load. However, here again the rapid postglacial weathering may often be an indication of unloading following the withdrawal of glacier ice as much as intense recent frost riving.

In the Arctic, fine-grained surficial sediments experience strong seasonal movement of soil moisture. The concentration in the active layer above the permafrost for part of the year as ice, and, in the thaw season as water, is frequently excessive even in what are nominally arid climates. Moisture also migrates to the permafrost table remaining indefinitely as ground ice. Moisture transfer and accumulation is responsible for much of the geometrically patterned ground particularly large ice wedge tundra polygons, frost heaving, including the formation of hummocks and larger mounds, and the downslope transfer of the regolith by solifluction.

Massive ground ice tens of metres thick underlies many lowland areas of the Pacific sector of the Arctic, notably in Canada around the Beaufort Sea and in northeast Siberia. Whilst its origin is not fully understood, when it is exposed, either naturally or inadvertently by Man, the ice thaws and spectacular forms such as ice cliffs, slumping and mudflows result.

The sensitivity of northern terrains to human interference is closely related to the soil thermal regime and the ice content. Terrain is particularly susceptible to disturbances that disrupt the plant cover and lead to thawing of perennial ground ice. Although eventual recovery may occur on level ground, deep thawing, particularly on slopes, may lead to irreversible changes, particularly gullying. Terrains are also sensitive to natural climatic change although generally on a long time scale to be measured in centuries and millenia before a new equilibrium state is achieved.

The fundamental question in the analysis of periglacial landscapes is the extent to which the geomorphic processes have produced a unique global landscape. To processes already described should be added two others, the role of snow (the nival processes) and the work of the wind (the aeolian processes). Nivation hollows, ledges and depressions, often filled with semi-permanent snowbeds are a conspicuous element of many arctic landscapes, but the rate at which they form, how they form and indeed the role of snow in the process remains poorly defined. Where snow is associated with geomorphic processes, it must be remembered that its distribution is related to the wind (Thorn, 1978). On a more general scale, the action of wind in deflating sediments is pronounced in glacier outwash zones and deltas but in the Arctic as a whole its geomorphic role may be slight.

In this paper principal attention has been given to the glacier-free lands, and indeed if we exclude Greenland, 90 per cent covered by glaciers, as a special case, 94 per cent of all other arctic lands are ice free. However, more than 2 million square kilometres of the Arctic have a glacier surface: the glaciers varying in size, morphology and dynamic characteristics from diminutive cirque and valley-side glaciers to the large ice caps such as those of Devon Island, Northeast Land and northern Novaya Zemlya. The source of moisture for the glacier ice is predominantly the Atlantic Ocean (and its poleward extensions) and for this reason the circumpolar distribution of glaciers today, as in the past, is skewed to the "Atlantic" sector. For the geomorphologist, arctic glaciers in the coldest lands and these include most of northern Canada and northern Greenland have unusual properties due mainly to the the low temperature (far below 0° C) of the ice. At low altitudes in summer, rivers flow in ice gorges on the glacier, there are deep moats along the sides of valley glaciers, small ice-dammed lakes are common and the end of the glacier may be vertical ("Chinese Wall") or have bulldozed into frozen morainic and outwash sediments forcing them into a jumbled mass of blocks of glacial debris and ice.

Mention must also be made of shelf ice along the coast which usually formed of ice from several sources: glaciers, snow and frozen seawater. During the Pleistocene glaciations, shelf ice played an important role in the dynamics of the ice sheets, but today the only large shelf in the northern hemisphere, a relic of earlier, harsher environments, is preserved along the northwest Ellesmere Island coast.

Artic terrains are frequently described as zones of active denudation (Budel, 1982), but it is by no means certain that this is always the case. It must be expected that in a region as large as the Arctic, containing many rock types, considerable variations in climate and widely different geologic histories, that there will be a broad range of denudation rates. The greater part of the non-glacierized Arctic probably differs only in its micromorphology from any mid-latitude areas, especially when they both experienced glaciation in the Pleistocene. Whilst it is evident that the detail has attracted major attention, it is only where there are widespread unconsolidated sediments that the unique periglacial features overwhelm the other landform elements, as they often do around the Beaufort Sea and in the Sverdrup Lowlands of the Queen Elizabeth Islands. But even here, and most certainly in other parts of the Arctic, fluvial activity dominates landscape denudation and only the patterns of stream discharge and channel development differ from middle latitudes (McCann and Cogley, 1973).

This paper has presented a conservative view of periglacial morphological processes. Great theoretical advances in understanding the dynamic aspects of northern landscapes have been made in the past quarter century and the results translated into practical applications for the engineer and conservationist. Much of the scientific attention has been concentrated in the region of contemporary economic development, referred to in this paper as the Pacific sector. Close analyses of weathering processes and rates of denudation in other arctic areas particularly the differences between maritime Arctic environments, such as prevail around the Norwegian Sea and more continental environments should command attention in the immediate future.

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Floral Processes

F.E. Wielgolaski

Introduction

The Arctic is a region of snow and ice, where some plants adapted to short growing seasons and to low temperatures may survive. Compared to temperate and tropical regions, the species diversity is low. Normally the number of species found within an area in the Arctic is less than 10 per cent of the numbers found in areas of similar size in temperate regions. Most plants are small, and when looking at arctic vegetation, at least from the distance, it seems to form a rather uniform carpet. Many of the arctic plant species have a wide or even circumpolar distribution, and they also occur in a wide variety of habitats. This further increases the uniformity of arctic vegetation. Beschel (1970) stresses that, therefore, it seems a relatively easy task to study arctic or tundra vegetation on a small area in detail and to arrive by extrapolation at an estimate which is applicable to most of the region. But he also mentions that this may not be true at all.

The flora of the Arctic has been studied for more than a hundred years. In the USSR, the country of the greatest arctic land masses, several scientists have tried to classify the vegetation of the region for a long time (review in Alexandrova, 1980). In the western hemisphere classification of arctic vegetation was started by Warming (1888) in Greenland. A real push to the understanding of floral processes in the Arctic was made by the work of the international tundra group within the IBP (International Biological Program) in the 1960s and early 1970s, as may be seen from the great amount of literature resulting from the IBP Tundra work (Tieszen, 1978; Bliss *et al.*, 1981).

Vegetation Structure

It is difficult to discuss arctic vegetation without mentioning a broad transition zone to the typical boreal forest. Scattered trees may be found in this transition zone, the sub-arctic region. Because of deeper soils and also greater continentality across the Soviet Union than in other northern countries it has been easiest to define zones of sub-arctic and arctic vegetation in USSR. In Canada, the last glaciation removed much of the soil. This has caused a mosaic pattern of vegetation depending on climate, soil and topography, instead of clearly defined zones.

The northernmost trees in the world are members of the genus larch (*Larix*). They are found in the Khatanga river basin of the USSR at nearly 73° N (Alexandrova, 1980). Although we call them trees, they are more like prostrate krumholz with short, crooked stems and thick branches. They are completely flattened to the ground and almost hidden in a moss carpet and surrounded by plants that prefer a thin snow layer. This means that the snow cover disappears relatively early in spring and that the growing season may exceed 120 days. On the other hand low winter temperatures (an average of less than -10° C is recorded from the Khatanga river basin in January) and probably also high wind speed, may destroy the tree buds rising above the average snow cover and prevent growth to taller trees.

The thin snow cover and low winter temperatures generally mean that there is permafrost in the ground down to several metres, even south in many so-called forest tundra areas with scattered trees. Only the upper layer melts in the summer. And this shallow layer, of the order of 50 centimetres or less, is enough for some tree species to establish and grow, for instance some species of the coniferous genera larch (*Larix*) and spruce (*Picea*). They may thus survive with roots down in the cold and often frozen soil. Due to the ice in the soil, drainage of water is slow, so in the summer plants growing here are nearly drowned because of lack of oxygen for the roots. This is probably one of the main reasons for the very small annual growth of black spruce (*Picea mariana*) often found in the north of Canada, in spite of the relatively high summer temperatures in most continental forest tundra areas.

High air humidity is probably the main reason for a good growth of birch in sub-arctic marine climate. It is the same species of birch (*Betula tortuosa*) that generally forms the arctic tree line in Iceland, northern Scandinavia, and eastwards into the Soviet Union approximately to the northern Urals, where larch takes over. This birch species also forms the upper tree line in western mountain areas at lower latitudes in Scandinavia. In fall there seem, however, to be some differences between these trees at lower latitudes and trees of the same species further north. The normal fall colour of the birch leaves in the southern areas is light yellow. But between them and the yellow trees in the north there are often found bright red ones. This looks really surprising, but may have a relatively simple explanation. A shrubby species of birch, *Betula nana*, gets red leaves in fall. In the short summer at high latitudes this species flowers at approximately the same time as the treeformed species. Hybridization between the two may occur relatively easily. When we see a red coloured birch tree, it thus means that dwarf birch "blood" probably is found in the tree.

The forest tundra may in a way look like a savanna vegetation or be somewhat denser. It is thus light enough for other plants. Normally it is found as a well developed vegetation cover below the trees. In mesic habitats there are several shrubs, sometimes 1-3 metres high. In nutrient rich and moist soil, tall forbs and grasses grow below the shrub layer, and often a thick moss cover is found in the bottom. This rich dense sub-arctic plant community type is really difficult to walk through. Maximum annual production figures may be very high, nearly 1 kilogram as dry weight per square metre (Table 1), half of which is above-ground production from flowering plants. This yield is higher than the production of the prairie. The reason of course is the much better water conditions in the subarctic, with relatively low evapotranspiration due to moderate summer temperatures.

For a long time scientists have discussed the reason for the climatic tree-line. Generally, temperature during the growing season seems to be the most important single factor. Vegetative growth of Norway spruce (*Picea abies*) and Scotch pine (*Pinus sylvestris*) stops if the average temperature of the four summer months (June-September) is below about 8.4° C (Helland, 1912). Even higher temperatures are necessary for seeds to ripen and germinate, above 10° C in the same period. Birch may grow at about 1° C lower summer temperatures than the two coniferous species mentioned, and willows grow at temperatures above *ca.* 5.5° C in the same four summer months. Therefore, willows often grow far north of the climatic tree line, but the height generally decreases to the north. Just before they disappear the shrubs are less than 25 centimetres high, while close to the tree line the same species might be 1-3metres high. The willow thicket belt is often called low arctic tundra; but in the colder part of the region only, dwarf shrubs of various species are found. Close to the tree line the annual production in the low arctic tundra may be as high as in the forest tundra, but on the border to the high arctic it is less than one-quarter of that maximum. A total annual production of 300 grams is observed as dry weight per square metre. Not only the shrubs diminish northwards, but also all forbs and grasses that need the shelter from the shrubs. This of course also influences the amount of material produced. In the low arctic various meadow types are quite common, but normally they disappear to the north.

At the highest latitudes vegetation cover is scarce or plants are totally missing in the few ice and snow free areas. Alexandrova (1970), found that cryptogams, particularly lichens, but also mosses, may totally dominate these northern-most ice free areas – often called polar deserts – both in respect to cover and weight. She has found only twenty-two per cent of the total dry biomass in these areas to be flowering plants. The total dry weight produced annually per square metre in the polar deserts seldom exceeds 10 grams. In spite of the dominance by cryptograms, however, this vegetation generally contributes a relatively small fraction of the total production in polar deserts because of the very slow growth.

Table 1: Plant production for the various regions of the tundra biome (Wielgolaski *et al.*, 1981)

Region	Alive standing crop: net production	Net production ($g\ m^{-2}\ year^{-1}$)	Production (%)		Net production Shoot: Root	Growing season (d)	Productivity ($g\ m^{-2}\ d^{-1}$)
			Vascular plants	Cryptograms			
High Arctic							
Polar desert	1:0.03-1:0.1	1-10	30-90	10-70	1:0.2-1:0.5	30-45	0.03-0.2
Polar semi-desert	1:0.02-1:0.1	10-50	20-95	5-80	1:0.2-1:1	45-60	0.2-0.8
Low Arctic-low alpine							
Herbaceous	1:0.01-1:0.15	100-200	60-90	10-40	1:1-1:3.5	45-100	2.2-3.0
Dwarf shrub species	1:0.1-1:0.4	150-700	65-85	15-35	1:1-1:5	50-150	3.0-4.7
Low shrub	1:0.2-1:0.5	500-1200	70-85	15-30	1:0.7-1:1	50-150	8.0-10.0
Antarctic							
Herbaceous	1:0.3-1:0.8	800-1000	80-85	15-20	1:1-1:1.7	150-200	5.0-5.3
Bryophyte		450-700	–	–	–	100+	4.0-7.0
Sub-Arctic-sub-alpine	1:0.2-1:0.8	150-800	50-90	5-50	1:0.3-1:1.3	110-365	1.4-6.5
Sub-Antarctic	1:2.2	5500-6000	–	–	1:0.2-1:1.9	170-270	20-35

Table 2: Average ratios of tundra biomass in some vegetation types (Wielgolaski *et al.*, 1981)

Region	Shoot to root (live)	Green to non-green live vascular plants	Live to dead above-ground vascular plants
Desert and semi-desert	1:0.9	1:2.3	1:1.9
Wet sedge meadows	1:21	1:23	1:1.6
Mesic-dry meadows	1:5.0	1:7.7	1:0.8
Dwarf shrub tundra	1:3.1	1:12	1:0.6
Low shrub tundra	1:2.0	1:19	1:0.2
Forest tundra	1:0.8	1:15	1:0.1

In between the extreme polar desert and the low arctic, some scientists define a transition zone type called polar semidesert. The percentage of mosses may be as high as in the true polar desert but the relative amount of lichens is lower. More flowering plants are found. The total annual plant production increases up to 50 grams dry weight per square metre on the border to the low arctic zone (Wielgolaski *et al.*, 1981).

Of the flowering plants, herbaceous species with appressed leaf rosettes and cushion and other mat-forming plants tend to occupy the zones of lowest temperatures, normally in relatively nutrient rich but moderately moist soil. Some grasses and sedges also survive very well in extremely low summer temperatures. But they have a low cover percentage in areas with low precipitation, and coarse, dry soil, as is generally found in polar deserts and semideserts, except during thawing in early summer, when it is often extremely wet in the soil.

In lower arctic latitudes, most of the grasses and sedges are single shooted and have rhizomes, long shoots in the soil. In somewhat drier soil, the dominating grasses and sedges are tufted with no or only short rhizomes. Shrubs, even dwarf species, are not able to survive in polar deserts and semideserts, nor in the coldest parts of the low Arctic. Evergreen shrubs tend to dominate in the most nutrient poor communities of the low Arctic (Wielgolaski and Webber, 1973).

Functioning of Tundra Plants

The ability to maintain growth in low temperatures is one of the most important adaptations for arctic plants. Many flowering plants – as well as mosses and lichen species in the tundra – have positive net photosynthesis even far below the freezing point. The lowest values are observed for the lichen *Cetraria nivalis*, which is common on nearly snow free wind swept ridges both in alpine and Arctic regions. This species is found to continue growth down to -20° C in sub-Arctic Finland (Kallio and Karenlampi, 1975). Several other lichen species have shown net CO_2 - uptake below -10° C in laboratory experiments. Some mosses are also found to have similar abilities, at least down to nearly -10° C, as observed in sub-Arctic Finland for instance for the moss species ***Rhacomitrium lanuginosum*** and *Dicranum elongatum*. At these low temperatures, however, the growth is of course very small. But at 0° C the photosynthetic rates are found to be substantial in both lichens and mosses.

In some lichen species, for instance in a Spitsbergen strain of *Stereocaulon paschale*, the optimum temperature for growth is close to 0° C (Lange, 1965), an amazing adaptation to arctic conditions! Strains of the same species from more southern latitudes, however, show considerably higher optimum temperatures. Similar growth temperatures have also been found for various species of mosses as well as for several higher plants, for instance conifers. Plants based on seeds from high latitudes generally are adapted to short growing seasons and stop their growth too early in summer if transplanted to southern latitudes.

Above-ground parts of several of the beautiful flower plants of the Arctic may continue to grow down to nearly -5° C, for instance the forbs mountain sorrel (*Oxyria digyna*), trailing azalea (*Loiseleuria procumbens*) and glacier buttercup (*Ranunculus glacialis*) (review in Tieszen *et al*, 1981). Also the roots of these plants grow at lower temperatures than in temperate regions, often close to 0° C. Their optimum temperatures for growth, however, may be surprisingly high, above the ambient temperatures they normally are exposed to in the Arctic. On the other hand, about 10° C is observed to be the optimum temperature of several species, for instance of the Arctic grass (*Dupontia fisheri*, as well as for the sedge *Carex stans* and the well known mountain and Arctic avens (*Dryas*).

The glacier buttercup was early found to accumulate nutrients and carbohydrates produced by several years of photosynthesis in its vegetative parts (for example in leaf bottoms and roots), until the surplus of available energy is sufficient for flower production (Resvoll, 1917). Similar accumulation is also found in other perennial tundra plants, for instance in all woody material above and below ground of the herb-like dwarf willow (*Salix herbacea*). This is an adaptation to the extremely short growing season often found at high latitudes. It may also take more than one year from the first initiation of flowers to ripe seeds. The life cycle of plants may thus be much longer in the Arctic than in similar species at lower latitudes. This is also commonly found for the life cycle of several insects in cold climates. Extended life cycles thus seem to be a general adaptation to low temperatures and short seasons for biological activity in the Arctic.

An important link exists between life forms and ecological functions. This may be especially true in arctic vegetation, which is often extremely sensitive to small differences in temperature. Greatest solar interception per unit leaf area and thus highest leaf temperatures are generally found when radiation reaches the leaves at right angles. In many parts of the world leaf temperatures are then too high for optimal growth. At high latitudes, however, the solar angle is low and temperatures are often below optimum for plant growth, at least in moist situations (Tieszen *et al.*, 1981). This means that presence of vertical leaves in arctic regions may be linked to high production. And many plants in the Arctic have nearly vertical leaves, especially grasses and sedges. In single shooted species within these plant groups the shading effect is moderate even for the inner nearly vertical leaves. As plants of this life form normally grow in very wet conditions, the leaf temperatures seldom is over-optimal, even on the nearly vertical unshaded leaves, because of cooling by evapotranspiration. These monocotyledons, therefore, often show high photosynthesis, and this may explain why this life form is favoured by the low solar angles at high latitudes when the soil moisture is high enough.

Plants with leaves near the soil surface, always receive a heat surplus from the ground during the day, particularly if the soil is dry. To prevent overheating, these species, therefore, normally have high temperature optima for photosynthesis. Some of them, however, show a mid-day depression in CO_2 uptake (Svetsova and Voznessenskij, 1970), as for instance mountain avens (*Dryas*). During this period the stomata on the leaves are closed to prevent too much waterloss by evapotranspiration in the high temperatures. For plants exposed to above optimal temperatures, it will be an advantage to decrease the light interception per unit leaf area (Tieszen *et al.*, 1981). If the total leaf area is limited by water, minerals, or slow growth rates, decreasing the interception per unit leaf area can be accomplished by clumping leaves as seen in the dwarf shrubs mountain avens (*Dryas*) and in crowberries (*Empetrum*).

Tundra plants in dry environments are normally also protected from water loss by accumulation of several dead leaves among the living ones. This is true both for the species mentioned above and for other dwarf shrubs and cushion plants, as well as in most plants with horizontal leaves in appressed rosettes, and also for tufted grasses and sedges. Because of the slow decomposition rates in low temperatures of the Arctic, dead leaves will remain for several years. Arctic plants like others may also reduce water loss by reducing leaf size or producing a dense hair layer. This will be a help to store the incoming heat as well. Crowberries (*Empetrum*), for instance, have very small leaves, while for instance the alpine chickweed (*Cerastium alpinum*) have hairy leaves.

The mountain sorrel (*Oxyria digyna*) and the glacier buttercup (*Ranunculus glacialis*) are examples of plants with nearly horizontal leaves, particularly in spring. They normally grow in moist soil and have an important growth period in early spring just after snow melt. During these moist periods an increased temperature may be favourable, and this may be obtained by the heat surplus passing from the soil to the horizontal leaves.

Many arctic plants adapt to the short growing season just by having the very rapid growth in spring as soon as the snow melts off. This is extremely important in snow beds where the extreme late snow melt results in very little photosynthesis before most of the snow is melted, at least if the soil is frozen. In some cases, however, growth starts even before the snow has disappeared in spring because of penetration of sunlight through up to about 50 centimetres snow cover, depending on the consistency of the snow. Plant growth under the snow takes place only if the upper soil layer is not frozen, but this may often be the case in late winter after a good snow cover. The growth explosion in spring is mostly an elongation of small leaves formed the previous fall and protected by bud scales and sheaths at the base of the shoot through the winter. This elongation demands a rapid and abundant supply of both energy and nutrients from a well developed winter storage system.

The flowers of the glacier buttercup, mountain aven and several other arctic plants show a parabolic form. This is used to "collect" as much sun as possible. Often the flowers also change their direction with the time of the day so as to always be open towards the sun. This may be particularly important for white flowers which reflect more of the radiation than darker colours. One reason for finding white flowers in the Arctic may be the attractiveness to this colour to insects necessary for their pollination. Very interesting is the colour change in the glacier buttercup from white in young flowers to dark rose in older ones after pollination. A theory is that a higher temperature in the older flowers with the darker colour is necessary for seed formation.

Adaptation to the short growing season in the Arctic (often less than eight weeks) and low average growth temperatures (commonly less than 5° C) may explain the large proportion of live non-green compared to green biomass often found in tundra. As much storage carbohydrates occurs in roots in graminoids (grasses and sedges), this often means a great root biomass compared to that in the tops of these plants (Table 2). In forbs much of the storage material may also be found in roots and the same is true as for graminoids. But the main storage of forbs may be in the shoots. Woody plants (trees and shrubs of all types) store as much material in woody above-ground parts as in roots. Translocation (transport of carbohydrates and nutrients) takes place most strongly in fall and early spring, between storage organs and growing points, particularly roots (Chapin and Shaver, 1985). This transport and transformation, however, demand a lot of energy.

In extreme climatic conditions, sufficient energy may not be available to support both the storage and translocation systems. Plants, for instance in high Arctic polar desert, therefore, often are adapted to reduce the translocation by keeping the green leaves all year. This is the case for many of the polar desert forbs, grasses and sedges, which do not have the high root mass – compared to tops – as observed in the less extreme lower Arctic regions. Instead, the energy and nutrients are stored in the leaves which are nearly evergreen, although the leaf tips are normally dead. It is observed that in the Canadian high Arctic tundra the lower parts of leaves in the middle of densely tufted Hepburns sedge or nard (*Carex nardina*) live 4 to 6 years (Svoboda, 1977). In some plants in the high Arctic polar deserts many leaves are reddish in winter, but do not die. These leaves turn rapidly green again in spring when new chlorophyll is synthesized. At lower latitudes the leaves normally die during winter in the same species. This is found for instance in mountain avens (*Dryas*) and in some saxifrages (*Saxifraga*) growing on exposed rocky cliffs. Similar adaptations are found in highland rush (*Juncus trifidus*) and in Bellard's kobresia (*Kobresia myosuroides*) also growing on exposed ridges.

It has been observed that leaves of evergreen dwarf shrubs, common in dry, nutrient poor and wind-swept ridges in the low Arctic, remain active for two to three years (Flower-Ellis, 1975; Callaghan and Collins, 1981). It has already been mentioned that shrubs close to their border for survival have to be low and creeping to be protected by some snow cover against the lowest temperatures, but also not to be too strongly exposed to wind. In the extreme high Arctic the conditions are normally too harsh for the above ground reserves in woody parts and buds of even evergreen dwarf shrubs. That is probably the reason why all shrubs normally are missing here.

When the leaves stay more or less green in winter, the plants may not need to transport carbohydrates and mineral nutrients from and to the leaves in fall and spring, respectively, and thus save energy. And they can utilize the radiation from early spring for photosynthesis in the old leaves (Tieszen *et al.*, 1981). Therefore, evergreens often have a late bud break in spring. But nutrients may be moved from old leaves to the new growth places when needed. This internal nutrient circulation may be seen as an adaptation in evergreen plants to growth on nutrient poor soil.

The environmental factors in the Arctic thus select for various growth forms through adaptation and specialization to the conditions found. This is particularly true on land. The environmental variation is less extreme in the sea, and therefore the changes are smaller from temperate to high Arctic regions than on land. In the sea local shelter effects in bays and near islands or reefs seem to mean more for the variation in sea weed species than the latitude. But there may be some adaptations to low temperatures or long days as mentioned for land mosses and lichens. The temperature changes, however, are less sudden in the Arctic Sea than on land. The plants do not need to specialize to the same degree.

Use and Conservation of Sub-Arctic and Arctic Vegetation

The cold regions of the world are becoming more and more popular for tourists, as well as for oil exploitation and to some degree for mining. All the activities pose great danger to the generally fragile vegetation in the region. The compaction of the permafrost soil by all sorts of vehicles causes the upper frozen layers to melt. This results in lowered tracks in the soil often filled with water. The rehabilitation of the vegetation takes several years.

Even walking may disturb the arctic plants for a long period, particularly on dry, nutrient poor soil. I have noticed that daily trampling by approximately 10 people in a 10 day period is enough to disturb for several years both lichen covered dry soil and moss covered moist areas in the Arctic. The increased tourism in the region, therefore, has to be controlled. At Spitsbergen – the Norwegian arctic area – efforts were made to limit tourism by few and small overnight facilities, by regulation in the large protected areas (both national parks and reserves) of the archipelago, and by general hunting regulations. In the long run it is probably more difficult to restrict the industrial efforts in Arctic regions. The results of arctic oil exploitation were seen early in, for instance, the northern parts of North America (Fuller and Kevan, 1970), although care was taken to limit the damage to nature.

In the Arctic, and particularly in the sub-arctic, there are also some influences of agriculture in a broad sense. This may include reindeer herding, as well as forestry in the forest tundra. Domestic reindeer is common at least in northern Fennoscandia and parts of northern USSR. The reindeer cause considerable damage to the vegetation both by their grazing and their trampling. The strongest influence is seen on their winter grazing areas, mostly wind swept areas with shallow snow cover, and pine forest tundra areas. In many areas there is interest in increasing the number of reindeer within the area because of their value to man. But to do this it is necessary to know the sustained productive capacity, particularly of their winter grazing grounds. Such studies are carried out for instance in northern Sweden (Eriksson, 1970), and are now under way at Spitsbergen, Norway.

In the forest tundra the reindeer is supposed to cause damage to tree seedlings by digging down to the ground to get food. Eriksson (1970) stresses the effects of controlled burning of the clearings in northern pine forests. The Lapps maintain that fire damages for a long time the lichens of importance to reindeer. Forestry people consider that the increased growth of grass after the burning probably compensates for this loss.

The sub-arctic birch forests in oceanic northern areas have traditionally been seen as of little value to forestry. Birch wood has locally been used for burning but has not as yet been used much in industry. This may now change through modern methods in pulp and paper production. One of the tasks of the inter-Nordic sub-arctic birch zone program (Anonymous, 1983), is to study the production ability of the trees of this region before the forests are damaged by cutting. It is well known that growth of the sub-arctic trees is slow. Therefore, it is important to know beforehand how much might be harvested and how often it is possible to harvest an area. In other sub-projects of this program various aspects of the understorey are studied, and so are problems of various birch provenances. To find the best provenance may, in the future, be of importance for birch planting in the region.

Generally, there are still important gaps in our knowledge of sub-arctic and arctic vegetation. More research has to be carried out both on structure and function of the plants in the region, and we have to find the best way to repair damage caused by man. We must be aware that if plant species of the region are extinct, this is a loss of genes which in the future may be of as great importance to mankind as those lost in temperate or tropical areas.

Summary

Many of the arctic plant species have a wide, even circumpolar distribution and occur in a wide variety of habitats. Most of the plants in the real Arctic are low and seem to form a rather uniform carpet from the distance. In a closer view, however, there may be great differences in the vegetation, for instance, because of microtopography, which influences the depth of thaw in the soil and other factors.

Permafrost is one of the characteristics of the Arctic, but is also often found in the sub-arctic, a broad transition zone between the real Arctic and the boreal forest. In the sub-arctic scattered trees are seen as in the savanna, mostly coniferous species as spruce and larch. But in more oceanic regions birches form the arctic tree line, mainly due to summer temperatures. In mesic habitats there are several shrubs in the forest tundra, and in nutrient rich and moist soil, tall forbs and grasses grow below the shrub layer, and a thick moss layer may cover the soil. Production of the sub-arctic may then be high, but at least as high values may also be seen north of the tree line in rich and moist low Arctic shrub communities with tall forbs and graminoids (Table 1). Further north in the low arctic region dwarf shrub heaths predominate in less extreme climates and in relatively dry and poor soil. Wet sedge-moss communities are common even in colder parts of the region. In the high Arctic the vegetation cover is scarce or plants are totally missing in the few ice and snow free areas. Cryptogams may dominate in these northernmost ice free areas with a very small plant production. Of flowering plants, herbaceous species with appressed leaf rosettes and cushion and other mat-forming plants tend to occupy the zones of lowest temperatures. Some grasses and sedges may also survive very well in extremely low summer temperatures if the soil is not too dry. Woody plants do not grow in the real high Arctic.

Some flowering plants as well as many mosses and lichens in the Arctic show positive net photosynthesis even far below the freezing point, the lichen *Cetraria nivalis* for instance down to -20° C. At the lowest temperatures, growth is of course very small, but even at 0° C photosynthetic rates are found to be substantial in many lichens and mosses. Aboveground parts of some flowering plants may continue to grow at nearly -5°

C for instances mountain sorrel (*Oxyria digyna*), trailing azalea (*Loiseleuria procumbens*) and glacier buttercup (*Ranunculus glacialis*).

Both the last mentioned species and some other arctic plants are also found to accumulate nutrients and carbohydrates through several years until the surplus of available energy is sufficient for flower production. It may also take more than one year from the time the first buds are initiated to the time they are ripe seeds. The life cycle of plants may thus be much longer in the Arctic than in similar species at lower latitudes.

At high latitudes the solar angle is low and temperatures are often below optimum for plant growth, at least in moist situations. This means that presence of nearly vertical leaves, as often found particularly in graminoids in arctic regions, may be linked to high production. Plants with leaves near the soil surface (for instance plants with appressed rosettes), always receive a heat surplus from the ground during the day, especially if the soil is dry. To prevent too much water loss by evapotranspiration plants may then clump their leaves, accumulate several dead leaves between the living ones or reduce the leaf size, for instance the dwarf shrubs mountain avens (*Dryas*) and crowberries (*Empetrum*). Plants may also produce a dense hair layer, as for instance in the alpine chickweed (*Cerastium alpinum*).

The first growth explosion in spring may need a rapid and abundant supply of both energy and nutrients from a well developed winter storage system. In graminoids most of the storage material is found in roots, and this may explain the low shoot to root ratios often found in low Arctic plants (Table 2). In extreme climatic conditions sufficient energy may not be available to support both the storage and translocation systems. Plants, for instance in the high arctic polar desert, therefore, often are adapted to reduce translocation by keeping the green leaves all the year round. This is the case for many of the polar desert forbs and graminoids, which do not have the high root mass to top ratio observed in the less extreme lower arctic regions. Instead, the energy and nutrients are stored in the often evergreen leaves, and they are able directly to utilize the radiation from early spring.

The driest and the wettest vegetation in the Arctic is particularly fragile to various types of activities. All sorts of permafrosted areas are influenced for a very long time, for instance by use of motor vehicles. The frozen soil is then compacted which causes the upper layers to melt. This results in lowered tracks in the soil, often filled with water. In the long run it is probably more difficult to restrict industrial efforts in arctic regions than tourism, but it has to be done, in part to make sure that the plant genes of arctic plant species are not lost forever.

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Faunal Processes

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Introduction

The arctic and subarctic regions of Canada cover 4 million square kilometres, extending south in James Bay and along the Atlantic coast to 50° N. This vast region has a human population of less than 100,000 concentrated in coastal settlements or along major rivers such as the Mackenzie, Yukon and Thelon. The faunal resources of the Arctic are characterized by large numbers of individuals of relatively few species, most of which are, to varying degrees, migratory and concentrate in large aggregations especially during the breeding season.

Until recent historical times, subsistence hunters were relatively few in number, their hunting techniques were time-consuming and long-distance travel was slow. Consequently, the subsistence hunters had relatively little effect on the wildlife and if faunal resource became reduced in an area, the people moved to take advantage of better opportunities elsewhere, or starved. The well-being of faunal resources was largely dependent on environmental factors such as snow and ice cover or untimely sleet and rain storms. From the later 1800s to the mid-1950s, there was a large influx of whalers and traders which stimulated major demographic and technological changes including the establishment of trading posts. Trading posts, especially in the eastern Arctic, were often located near safe anchorages for large ships and not necessarily close to terrestrial wildlife resources. Increased concentrations of people and enhanced methods of travel have led to severe local reductions of some faunal resources. Since the 1950s, numerous trading posts have become settlements. Outpost camps in many areas have been abandoned except for an occasional visit. The withdrawal of people to permanent settlements has created large areas where fauna are not exploited.

In this paper we briefly address three broad faunal groups and deal primarily with exploited species: (a) birds; (b) terrestrial mammals; and (c) marine mammals. Of particular importance to this discussion is the way that life history strategies of these animals have evolved to survive in an unpredictably variable, and sometimes extreme, environment. The population dynamics of arctic fauna are characterized by long life, high adult survival rate, deferred age of first reproduction of females, and low reproductive rates. Arctic animals have evolved to cope with total breeding failure in some years by simply living and reproducing long enough to compensate for such losses. However, that reproductive strategy means that the capacity to cope with increased losses of adults (especially of adult females) through harvesting or industrial accident is low, and that populations affected in that way will be slow to recover. These points are significant to the making of decisions for the management of those species (Eberhardt and Siniff, 1977; Goodman, 1981).

Current Knowledge of Avian Resources

The distribution during the breeding season of birds which feed in terrestrial or littoral habitats, and which may winter as far south as Antarctica or Africa, is largely restricted to areas which were flooded by marine or fresh water in the post pleistocene era or which have recently emerged as a result of eustatic rebound (Gaston *et al.*, 1985). Seabirds (Murres, Guillemots, and cliff-nesting Laridae) require persistent open water at the time of arrival and egg laying (Brown and Nettleship, 1981; Prach *et al.*, 1981). Areas of otherwise suitable habitat are not utilized, either because land fast ice persists at critical periods or the cliff front is north facing and does not thaw until too late in the year.

Species such as Snowy Owls (*Nyctea scandiaca*) and Ravens (*Corvus corax*) which are largely non-migratory have a wider distribution. Where they do nest on the tundra, they often make relatively short migrations, either into the boreal forest or areas which permit feeding during the winter.

The arctic regions also play an important role for non-breeding waterfowl such as Canada Geese (*Branta canadensis*) which either make moult migrations from southern breeding grounds or which overfly the southern prairies in years of drought (e.g., Pintail ducks *Anas acuta* and Mallards (*Anas platyrhnchos*).

The distribution and numbers of the arctic avifauna are not static, and some species' distributions have retreated and recolonized. For species such as Snow Geese and Brant (*Branta bernicla*), major changes have occurred since the end of the little ice age. For example, doubling in the numbers of arctic nesting geese, swans and cranes, has occurred since 1950, despite increasingly unfavourable climatic changes. Several small colonies of Lesser and Greater Snow Geese have irrupted since 1950 and active colonization is occurring (Boyd *et al.*, 1982). All five goose species have more than trebled in numbers since 1950, except for the four populations of Brant Geese which are either stable or fluctuating widely. Populations of alcids in the eastern Arctic are either stable or declining. They, like the Brant, have been subjected to increased mortality away from their breeding sites which are not necessarily related to conditions there.

While the success of the breeding season is largely determined by environmental conditions when the birds reach their breeding grounds in May and June, the physiological condition of many species is also determined by habitat conditions on the wintering grounds during spring migration. For Snow Geese, a winter and spring drought in Texas effectively reduced reproductive success at Baffin Island by preventing the birds from storing sufficient fat reserves before returning to the arctic (Davies, 1981).

Unlike most terrestrial and marine mammals the harvesting of which occurs mainly in the arctic, geese, swans, cranes, alcids, and some species of ducks incur their major mortality from hunting after they have left the breeding areas. This can pose serious problems for both residents of the arctic and southern inhabitants of the continent who may inadvertently overharvest the same stock of birds. Many avian species are extremely philopatric and overharvest on the arctic breeding grounds can occur without damaging continental stocks.

At the other end of the scale are species such as the Eskimo Curlew and Ross Gull whose absolute numbers are so low that they could easily be wiped out by carelessness.

Mammals

Current Knowledge

The degree to which research and management of mammals has been developed varies significantly between species, depending largely on their perceived population status and their traditional use by native people. The large number of people still dependent on caribou and the apparent decline in caribou numbers in the 1970s spurred many studies of caribou (*Rangifer tarandus*). Likewise, international concern over diminishing populations of polar bears (*Ursus maritimus*) brought that species to the forefront for funding of studies in the 1970s and 1980s. Research on the biology of other species except for management-oriented studies of numbers and distributions, even on large mammal species such as muskoxen (*Ovibos moschatus*) and grizzly bears (*Ursus arctos*) has languished in the doldrums for lack of funding. Species important to many native people such as moose (*Alces alces*) and furbearers have rarely been the focus of research efforts, again other than management surveys. Consequently our current knowledge of arctic mammals is uneven.

The focus of caribou studies has been monitoring the size of the major herds of barren-ground caribou which are either relatively stable in population trend (Beverly and Bluenose herds) or have rapidly increased in size

(Kaminuriak and Bathurst herds). The causes of the increases are debatable, but in 1984 the Kaminuriak herd, once the centre of controversy because of its apparent decline in the 1970s, now numbers 200,000 (Gates, in press) and the Bathurst Herd, 400,000.

The increase in caribou numbers may be a more widespread phenomena, though precise documentation is scanty. Large areas such as Victoria Island and northwest Keewatin have been so rarely surveyed that comparative data on population size are absent in the 1980s. Hunters from many communities in Baffin Island and the Central Arctic however, report increased numbers of caribou in the early 1980s.

The Committee on Endangered Wildlife in Canada declared the small white *pearyi* subspecies of caribou to be endangered after surveys documented a catastrophic decline in the numbers of Peary caribou on the High Arctic Islands between 1961 and 1974 (Gunn *et al.*, 1981). Subsequent ecological studies of Peary caribou documented how the severity of the winter influenced the caribou's body condition to the extent of reducing reproductive rates before individual survival was impaired (Thomas, 1982). Feeding habits and migrational movements, including the crossings on sea ice between islands, were also keyed to prevailing snow and ice conditions (Miller *et al.*, 1982).

The relationship between reproductive effort and environmental conditions has been observed in current studies of caribou on Coats Island. Similarly, the current ecological study of the Beverly Herd on its winter range from 1981-84 documented the environmentally-induced fluctuations in body condition and reproductive effort and shifts in winter range use as snow conditions varied between years.

Muskoxen have increased in number and recolonized many areas such as on Banks Island, southeast Victoria, north of Great Bear Lake and the Queen Maud Gulf area (Urquhart, 1982). The causes of and outcome of such increases are speculative (Gunn *et al.*, 1984) but hunters frequently express concern over interactions between the increased number of muskoxen and caribou. Studies of the feeding habits of muskoxen and caribou suggests no overlap between the two species (Thomas and Edmonds, 1984) but that knowledge may not be relevant to areas where both muskoxen and caribou are rapidly increasing in number.

The information collected by biologists and hunters during commercial hunts of muskoxen on Banks Island since 1981 further document the view that muskoxen have reproductive rates equivalent to caribou, and do not, in fact, have a low productivity except under severe weather conditions (Tessaro *et al.*, 1984). On Banks Island, average age of sexual maturity was 2.5 years in cows and most cows bred every year. Information from the High Arctic suggests that muskoxen adopt a similar strategy to most ungulates when faced with food shortage (when ice-snow conditions restrict forage availability): the muskoxen curtail reproduction before their survival is threatened. The exact mechanism (failure to conceive, or intra-uterine mortality or reduced calf viability) is currently uncertain though some evidence supports failure to conceive as a likely mechanism (Gunn, 1984a).

Hunters along the mainland Arctic coast have reported increases in numbers of observed barren-ground grizzly bears and also in bears raiding caches, campsites and Snow Goose colonies. In response to concerns over and interest in the bears, two studies of bear biology and distribution were initiated in 1985. One study has started to examine the status and ecology of bears on the Tuktoyaktuk Peninsula where previously, the only ecological study of the barren-ground grizzly bear ecology was done in the mid-1970s. That study documented a healthy population held in check by hunting pressure (Nagy *et al.*, 1983).

The ecology and population dynamics of furbearers, even the larger furbearers such as wolverine (*Gulo gulo*) and foxes (*Canis vulpes*) and Arctic fox (*Alopex lagopus*) is little known. Moose numbers are monitored in some areas but little is currently known about moose ecology - similarly for woodland caribou (*R.t. caribou*). Wood bison (*Bison bison athabascae*) have, however, been regularly monitored and Calef (1984) described the wood bison population in the Mackenzie Bison Sanctuary as one example of an irruptive population. The incidence of disease in and predation on the bison in the Wood Buffalo National Park is the focus of current studies with the emphasis on brucellosis.

The status of wolves is indirectly monitored through NWT Wildlife Service fur export records and, historically, from bounty payments (ceased in 1971). Wolves currently inhabit most all of their traditional range and at natural densities (Heard, 1983) though with some exceptions such as the Kaminuriak caribou herd's range (Gates, in press). The rapid increase in the numbers of caribou in that herd may be partially attributable to the scarcity of wolves (Heard and Calef, in prep). Wolves were rarely observed on the calving grounds in the late 1970s and 1980s; but in the early 1970s, wolves killed significant numbers of caribou calves (Miller and Broughton, 1974). For, at least, the calves of the Beverly Herd, however, wolves remain a significant cause of mortality. In certain situations those wolves on calving grounds will kill in excess of their nutritional needs when faced with large numbers of vulnerable prey (Miller *et al.*, 1985). Studies of wolves themselves, rather than their predator-prey relationships, have not developed since an initial study of radio-collared wolves in the late 1970s which showed non-breeding wolves followed the cows of the Bathurst Herd to the calving grounds - the breeding wolves denned along the treeline. Oosenbrug and Carbyn (1982) described wolf predation on bison in Wood Buffalo National Park. The reduction of bison in the Slave River Lowlands due to wolf predation, compounded by a severe winter in 1974-75, and human hunting, has been monitored by the NWT Wildlife Service (Heard, 1983).

Generally, the studies initiated in the 1970s because of potential or impending industrial development emphasized surveys of numbers and distributions. Knowledge was acquired to predict how many animals would be effected and where, but not how they might be effected. Likewise, areas used by wildlife during apparently vulnerable stages of their annual life-cycle were described but not the likelihood or results of changes in use of the areas as a consequence of human activity. That inadequacy in predicting the effects of human activities on wildlife has been recently recognized (Beanlands and Duinker, 1983). The Beaufort Environmental Monitoring Project is one example of the shift to a more rigorously scientific and ecological approach in environmental assessment but some other studies spawned by industrial activities have also recognized that knowledge of behaviour and ecology is required to predict the effects of industrial developments (Gunn, 1984b).

Most studies done to date have, partly out of necessity, been preoccupied with estimating population size for management purposes. Considerable efforts have gone into standardizing and refining techniques in the 1980s with a resulting increase in precision of estimates and repeatability of the surveys (Heard, in press; Kingsley *et al.*, 1985). Often, because of limitations of funds, weather, or simply scale, all the available habitat cannot be surveyed or sampled which leaves the chance for large but undetermined errors. Also, timing of surveys is influenced by the fact that most of these species are migratory or at least have fairly extensive seasonal movements which, in turn, can vary greatly from year to year depending on variations in factors such as ice conditions. For example, between 1974 and 1975, there were marked decreases in the numbers and reproductive rates of both seals and bears in the eastern Beaufort Sea (Stirling *et al.*, 1976; 1977; 1981). There was a correlation with heavy ice conditions which may also have occurred about 10 years earlier, but the actual mechanisms involved could not be determined. Although the overall numbers (and reproductive rates) appeared to recover between 1977 and 1979, there were large variations in the distribution and abundance of seals counted on the annual monitoring flights that could not be explained (Stirling *et al.*, 1981).

Eberhardt and Siniff (1977) list 12 criteria which might be useful for determining population trends or whether a population is near carrying capacity and conclude that the most useful may be subadult survival. Unfortunately, given our present knowledge of most arctic mammals, this is not yet possible or practical. This leaves us dependent upon a variety of survey types that have been used for determining relative abundance such as aerial surveys of hauled-up ringed seals (Stirling *et al.*, 1981), or counting of narwhals as they swim part of particular sites each year (Tuck, 1957, cited by Mansfield *et al.*, 1975) or counting the numbers of breeding cows on the caribou calving grounds (Heard, in press). Despite the difficulties, techniques for monitoring population trends and abundance remain a priority.

In Canada, polar bears have been hunted by Indians and Inuit for food and their hides for several decades. Some meat is still eaten by humans and dogs but such use is much less common that it was in earlier times. Through the 1950s, then particularly during the 1960s, the rapidly increasing value of polar bear hides in North America and Europe, coupled with the increasing use of oversnow machines, stimulated unprecedented increases in the reported harvest of polar bears. In Canada, between 1953 and 1964, the recorded harvest fluctuated between 350 and 550, while in 1967 it suddenly reached 726 (Schweinsburg, 1981). Because of the previous inadequacy of recording of harvest data, we will never know how many bears were actually killed up to the 1970s. However, there was sufficient concern about the conservation of the species that it was agreed that there should be international cooperation in its research and management and there is now in place an International Agreement on the Conservation of Polar Bears and Their Habitat. Because of the concern about the very survival of the polar bear, much of the initial research was concentrated on determining the size of populations, their discreteness, reproductive rates, population dynamics, and areas of critical habitat (see review by DeMaster and Stirling, 1981). Polar bears in Canada appear to be distributed in 10 to 15 relatively discrete subpopulations and each of these is managed independently. Population studies have been completed in the Beaufort Sea, the High Arctic, Central Arctic, and southeastern Baffin Island (Schweinsburg *et al.*, 1981; 1982; Stirling *et al.*, 1975; 1980; 1984). New population studies are now being undertaken on eastern Baffin Island, Hudson Bay, and Foxe Basin. With the passage of time, it has also been possible to shift some of the emphasis in polar bear research to more basic studies of behaviour, physiology, and habitat relationships which in turn have helped us understand the population surveys better (Stirling, 1974; Stirling and Latour, 1978; Stirling *et al.*, 1981; Oritsland *et al.*, 1977; 1981).

Similarly, because the species were being harvested or it was feared that offshore industrial activities might impact upon them, studies of seals and whales have tended to concentrate on determination of population size, critical habitats, and migration routes. Particular concern has been paid to populations of bowhead whales, narwhals, white whales, and walruses because of their perceived smaller numbers and vulnerability to overharvest. Several monitoring studies of whale populations continue to be funded by industry, such as those in the Beaufort Sea on white whales and Bowheads (Harwood and Ford, 1983) and reviews have been done on the perceived threats of man's activities on Arctic marine mammals (Geraci and St. Aubin, 1980; Stirling and Calvert, 1983).

Use and Conservation Implications

Most current knowledge of Arctic mammals has stemmed directly or indirectly from management concerns as almost all mammal and some bird species are utilized. Many people are still dependent to differing degrees on the direct utilization of wildlife for meat and to a lesser extent for clothing. The utilization of wildlife as a source of cash is increasing often as a result, ironically, of the rising costs of the subsistence lifestyle. Hunters without full or part time employment frequently rely on the cash from sale of, for example, seal pelts, walrus or narwhal ivory carvings to buy ammunition and gas for subsistence hunting for meat. The commercial utilization of wildlife is increasing also as a result of governmental initiatives to buffer the economies of settlements from the boom-and-bust cycle frequently associated with non-renewable resource exploitation. Ventures such as sport-hunting, commercial marketing of game meat and by-products, and the sale of gyrfalcons for falconry are examples of programs actively supported by the Government of the Northwest Territories.

The human population of the arctic regions is increasing at about 5 per cent per annum which may heighten the harvest levels. Additionally, commercial harvesting of wildlife can achieve a momentum of its own as economic expectations and investment returns inevitably start to play a role in harvest management. Thus, as harvest of wildlife increases and continues to shift from subsistence to commercial harvesting, the need for management research will increase, despite the considerable progress that has already been made, especially in the later 1970s and early 1980s.

The level of management and thus the need for management data varies considerably among species. For example, in the case of seals, there is essentially no management in the sense that no restrictions of any kind are placed on the numbers that may be taken or on the seasons in which they may be harvested. For most furbearers, and seals, the unstated assumption is that the populations are so large that unrestricted hunting will not reduce them except possibly locally. There are few data with which to test this hypothesis but so far it seems to have been adequate in practice. The native hunting of caribou is mostly unrestricted but the hunting or taking of polar bears, narwhals, muskoxen, bison and gyrfalcons is regulated by quotas. At the other end of the scale, the bowhead whale is classified as an endangered species and currently is not hunted anywhere in Canada although there is a limited quota for the Beaufort Sea population of Inuit in Alaska (Marquette and Bockstoce, 1980). The management objective for the hunted species of mammals has been maximum sustained yield (MSY). To calculate, or even approximate MSY for a population requires reasonably accurate information on population size, reproductive parameters and survival rates. These values are incomplete or not available for almost all populations of mammals. Furthermore, Eberhardt and Siniff

(1977) suggested that some species have been harvested so intensively and for so long, it is impossible to determine at present what the carrying capacity might be.

The use of catch per unit of effort by hunters has been considered to monitor population size or trends, but we would urge caution as hunters naturally go to places where numbers of prey species are most abundant and accessible. Consequently, even if a population is seriously declining, it will probably not be apparent because hunting in areas where the remaining animals are concentrating will give a false impression of abundance.

The trend toward commercial versus subsistence harvesting is only one aspect of the rapid social, economic and political changes in northern Canada. Those changes have and will continue to affect the conduct of research and research topics themselves as the hunters become more involved in management. Especially, in the 1960s and 1970s, hunters were rarely involved in management decisions and a gap widened between managers, biologists and hunters. One consequence of the emphasis on aerial surveys was the polarization of biologists and hunters - frequently, the hunter's only view of a biologist was a plane passing overhead. Communication between biologists and hunters was further hindered by the seeming insistance of biologists on only accepting objective and numerical information and the notion that populations were fragile entities to be zealously protected from overhunting. Yet there is much value to be gained by an interchange between two groups.

The need to integrate the scientist's and hunter's wildlife knowledge - if not the mechanism for doing - has been identified (Freeman, 1984) and the momentum toward interchange has been increasing in the 1980s. Recognition of common problems and political changes has led to joint efforts in the 1980s between government including biologists and hunters, for example, the Beverly-Kaminuriak Caribou Management Board and the Inuvialuit Game Council. Another example of the recent change in the relationship between biologists and hunters is the start of cooperative projects with Hunters' and Trappers' Associations in the 1980s to collect reliable harvest data. Previously, the absence of harvest data was one of the most glaring knowledge gaps for northern mammals and birds. Also, the NWT placement of regional biologists in the larger communities has led to more regular contact and development of mutual understanding as their programs emphasize travelling on the land and working closely with Hunters' and Trappers' Associations.

Research Directions

Conservationists as a group have a collective preoccupation with estimating the total size of particular populations. For example, "How many polar bears are there in the world?", is the most regularly asked question of a polar bear biologist. The answer is twofold. First, we don't know and second, it wouldn't help us much if we did because they are distributed in relatively discrete subpopulations which have to be studied and managed independently. One of the results of this preoccupation on the part of management-oriented funding agencies has been that not enough of our research is being conducted in areas such as theoretical ecology, behaviour, and physiology that might help us to actually understand the results of large surveys and what is happening in the populations.

Recently, World Wildlife Fund (Canada) initiated their Whales Under the Ice Program (WWF, 1983). Clearly, their goal was to help conserve whale populations in the Canadian Arctic but they took the enlightened approach of not just asking how to put more money into counting whales. Instead they insisted upon the identification of important studies of the biology of the species concerned which, if funded, might increase our knowledge in such a way that the whales could then be conserved more effectively. For example, aerial surveys of bowhead whales have been conducted in the eastern Beaufort Sea for several years, mainly to monitor possible influences of offshore hydrocarbon exploration on their numbers and distribution (Fraker and Bockstoce, 1980).

Similar surveys have been conducted of narwhals in the eastern High Arctic (Fallis *et al.*, 1983), and of white whales when they are concentrated in river mouths in mid-summer all over the Arctic (Fraker, 1980; Finley *et al.*, 1982). During those surveys, anecdotal observations have been made on such things as behaviour or distribution of age and sex classes (Wursig *et al.*, 1984) but they are difficult to interpret on a broader scale. Through the WWF program, detailed ecological and behavioural studies are being done on such things as: the feeding and behaviour of bowhead whales on the eastern coast of Baffin Island which is providing dramatic new information to use in the interpretation of surveys of the species throughout its range during the summer; the diving behaviour of narwhals so that correction factors may be developed to correct for the number of whales under the water when aerial counts are done; and, the behaviour and ecology of white whales in estuaries to determine why the animals go there in such numbers in the first place (World Wildlife Fund, 1983). We suggest this program exemplifies the value of process-oriented research to conservation of the species in the broad sense and could provide a useful model for future research on other species.

Migratory birds pose a somewhat different set of research requirements than do resident species of most mammals, in that factors regulating the well-being of a species or population generally cannot be studied solely in an arctic environment. Toxic chemical loads acquired during migration and on the wintering grounds have contributed to non-breeding of peregrine falcons and gyrfalcons. In addition, some prey species such as shorebirds winter as far south as Tierra del Fuego and import toxic chemical loads to the "clean" arctic environment. Those populations which are exploited for food and/or sport constitute a special problem since there are at present no firm estimates of the annual take from those species which winter south of the United States. As populations which breed in the arctic are geared to high survival of adults and generally have low average reproductive potential, they are particularly vulnerable to being overharvested. This is especially true of colonial species such as northern eiders which exhibit extreme philopatry, so that egg collecting and overharvest of adult females can literally wipe out a local population (Cooch, in press). The development of a gill net fishery off west Greenland has had a demonstrable impact on Thick-billed Murres taken during their swimming migration from Lancaster Sound. Similarly an accident involving liquid hydrocarbons could destroy significant maritime faunal resources required by all marine dependent avifauna. As with the arctic mammals the key to understanding the management of harvests and the effects of industrial activities lies in long-term ecological studies (Gaston *et al.* in press).

The most significant future needs for research stem not directly from the management of harvests but from the pressing requirement to understand the relationship between the wildlife and their habitats. As regional development plans are being drawn up, it is no longer sufficient to label areas as important for wildlife but those areas have to be justified and defensible in the face of competing land uses. The need to direct research toward unravelling the strategies used by wildlife populations in their interactions with each other and their habitats requires long-term ecological studies. Such studies can readily integrate knowledge and expertise of hunters as well as more conventional scientists. There is, among ecologists, a growing awareness that the strategies of wildlife interacting with each other and their habitats are more subtle and intricate than previously considered. Land use planning and harvest plans for wildlife should be directed through careful ecological studies to mould with this more sophisticated view of the natural world.

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Northern Limnological Processes: Research and Management

W. Peter Adams

Introduction

Purpose

Information and ideas on northern lakes are important for those interested in ecological, planning and management aspects of arctic heritage use and conservation. In many northern areas, lakes form a dominant feature of the landscape, in others they are relatively rare. In both of these cases, the lakes form a critical feature of the physical and biological systems of the region concerned.

Although arctic lakes are ice-covered for most of the year, more is known about their ice-free condition. In this paper there is a deliberate emphasis on conservation and management implications of lake ice, including snow cover. Useful reviews of arctic and subarctic limnology include, Hansen (1967), Hobbie (1973, 1984), Kalff (1970), Livingstone (1963), Rawson (1953), Rigler (1975, 1977) and Thomasson (1956). Standard limnological texts which include the ice-covered case are Hutchinson (1975) and Wetzel (1975).

Some Characteristics of Northern Lakes

On a global scale the lakes of the Canadian North represent a very significant proportion of the world's limnological resources. They also represent one end of a climatological spectrum of lakes which can be conceived as being bounded at the other end by the lakes of the hot, twelve-hour daylight regime, virtually season-free, equatorial zone. This makes northern lakes valuable scientifically as study of the extremes of such a spectrum is often an efficient way of identifying general features of it. Study of the effect of light on ecosystems, for example, can be usefully conducted in the extreme equatorial and high arctic situations. So can other effects of seasonality.

It is generally more productive to think of arctic phenomena in this way, in the context of global spectra rather than in terms of their being "unique". The origins of arctic lakes, for example, are generally similar to those of lakes elsewhere in the world but with particular regional emphases. Thus ice-dammed lakes, again for example, occur in non-arctic as well as arctic areas. The *special* feature of the North is their frequency of occurrence and scale (Maag, 1969; Hobbie, 1973, 1984). Mackay and Loken (1974) do suggest that thermokarst lakes *are* unique to the arctic. This is the sort of useful exception which should probably be accepted as proving a rule. In this same vein, it is not ice cover which is special to the arctic, it is the magnitude and persistence of lake ice cover.

In sum then, the lakes of the North merit attention globally both because they represent a large proportion of the world's lakes *and* because of their "special" features among the world's lakes. As well as being one of Canada's great natural resources, they are one of her great "scientific" resources.

Within the North, lakes form a dominant feature of the landscape of some very large regions. In the Mackenzie Delta and many parts of the Canadian Shield, for example, it is not unusual for lakes to cover well over 20 per cent of the landscape. In such regions as well as where lakes are quite rare (Canada 1978) they form a natural focus for abiotic and biotic, including human, systems. These lakes include some which are really very large on the global scale, e.g. Great Bear and Great Slave, as well as millions of smaller water bodies. When contrasted with low latitude lakes, northern lakes reflect a number of interrelated "special" features of their environment. These include low temperature, low insolation, marked seasonality of all climatic factors but notably, in this context, of light regime, youth, the presence of ice and permafrost.

Such features affect all northern systems. But their implications for lakes merit careful thought. Normally arctic water bodies are not, for example, subject to the degree of cold nor the temperature range of terrestrial arctic systems. In fresh water lakes, where water remains unfrozen, the lower limit is 0° C. In some cases the annual range in the unfrozen water may well only be a few degrees, although remarkably high temperatures do occur in some shallow lakes. Indeed, in lakes, the main impact of the arctic temperature regime may well be the development, persistence and decay of an ice cover with, all of the ramifications which are discussed below, rather than cold.

If light is taken as another example, the regime in lakes is dissimilar to that experienced by adjacent terrestrial systems because of the optional roles of the ice, including snow cover. Most often, the effect will be that the aquatic system will experience less light than its land counterpart. It can be argued that the much vaunted astronomical seasonality of high latitudes is replaced, for a lake, by a very long "covered" season and a short "open" season. The latter generally occurs after the mid summer period of peak solar radiation.

Youth is an important characteristic of northern lakes (Dunbar, 1968; Sokolov and Chernov, 1983). Whereas the evolution of lakes near the equator often involves millions of years, in the North a maximum age of between ten and twenty thousand years is normal. Even in areas which were not directly affected by the last glacial advance, the age of lakes is measured in tens of thousands rather than millions of years. In parts of the northern Yukon which have been ice-free throughout the Pleistocene, there may be lakes which are millions of years old. If so they merit special attention from scientific and conservation viewpoints as old lakes which have evolved in a very cold, desert, environment. In the glaciated areas the maximum age of lakes is least in regions such as Keewatin and Quebec-Labrador, which were deglaciated last (Prest, 1968). It is important to realize that there may be lakes close to present glaciers in the high arctic which are older than lakes located well outside the Arctic Circle which were deglaciated more recently. Age is a good example of a characteristic of arctic lakes which is *not* a function of latitude. Furthermore, while low latitude lakes have evolved in a warm, high solar radiation, environment, those in the North have developed in a cold, low radiation, environment. They have also evolved in a landscape which is, as a whole, young, and in an environment in which the supply of nutrients necessary for primary production in the lake is limited.

This difference in age and maturity is highlighted by the hundreds of fish species in low latitude lakes compared with tens of species present in northern lakes and only one in the high arctic. The simplicity of the arctic lake systems is one cause of their fragility, meriting special management care. While the production of fish in them is very low (in comparison to, say, zooplankton or benthic production in the same lake or in comparison to fish production in temperate lakes), the biomass of fish present may be very high, largely because northern freshwater fish grow slowly, reach maturity late and live to a great age. Anything which damages such a population or its environment, be it overfishing or "pollution", can have drastic effects from which it may take many years to recover. Populations of this type are liable to "collapse" dramatically, another reason for careful management, as such a collapse may be that of the only fish species in the lake. Useful references here are Johnson, 1975, 1976; McCart and Beste, 1979; McPhail and Lindsay, 1970; Rigler, 1974.

These youthful lake systems are part of a landscape which is itself youthful and which is occupied, especially in the tundra case, by youthful terrestrial ecosystems. This has important and complex implications for the chemical loading of lakes. In general, the inputs of elements into a lake from its catchment will be high during early stages of ecological succession (Gorham *et al.*, 1979; Vitousek and Reiners, 1975). Both amount and chemical nature of inputs will change as succession proceeds. Although this matter is complicated by the way in which snowmelt ions are retained by northern lakes, as is discussed below, these lakes in general are not short of major ions, quite the reverse, but they lack the critical, mainly atmosphere-derived nutrients, phosphorous and nitrogen, necessary for biological production.

Again, however, northern lakes, as one end of a spectrum from complex, highly productive, low latitude biotic systems to simple, low productive, high latitude systems, present special opportunities for study which are of value to the understanding of the entire spectrum (Rigler, 1977 and references).

A wide range of lake types exists in arctic and subarctic Canada, no matter which classification of lakes is used. Lakes are also located in a great variety of settings in terms of geology, physiography, glacial history and climate. Hydrologically the regimes of all lakes (glacier regimes excepted) tend to be dominated by the heavy throughput of a spring snowmelt preceded, where outlets remain unfrozen, by a winter of declining sub-ice water levels. This melt may occupy a few days involving quite tiny amounts of runoff in the high arctic. By contrast runoff is spread over weeks, with huge volumes of water in some subarctic areas (Dingman, 1973; Ives and Barry, 1974). There is also a considerable range in summer runoff conditions depending on the amount and type of summer precipitation, the magnitude of evaporation, the nature of catchment areas, e.g. muskeg vs. permafrost desert. Rain is a quite normal feature of subarctic and arctic climates with often spectacular runoff effects.

It is therefore necessary to make great generalizations in a short article like this. We will not, for example, pay great attention to what is "arctic" or "subarctic" although it is clear that presence/absence of permafrost or presence/absence of trees has profound implications for lake systems (Dingman, 1973; Hobbie, 1973, 1984; Ives and Barry, 1974; Saer, 1969; and Rawson, 1953). However, I would suggest that the best single factor definition of "arctic" and "subarctic" or even of "northern", lakes, may well be based on measures of ice cover.

In thinking about the characteristics of northern lakes it is important to recognize that area and volume are important lake properties. In discussing lake characteristics it is perhaps useful to think not of the large number of tiny water bodies which freeze solid and have no fish nor of the small number of very large lakes, but rather of a middle range lake. Our "model" lake is also a relatively isolated water body not simply an expansion of a river. This means for example, that currents do not play an important part in the evolution of its ice sheet. It also means that its fish productivity does not get a boost from runs of char fattened in the sea.

The Importance of Lake Ice Cover

In the case of lakes, the long, dark, winter season, which is a distinctive feature of all natural systems in the North, is accompanied by the initiation, development and decay and breakup of an ice cover. Indeed the cover can be considered as dominating the entire annual cycle of the lakes; it may extend the 24-hour dark season well beyond that produced by latitude. Understanding of ice cover and its roles within the hydrological and biological systems is a key to the assessment of the effect of continuous human use of the lake and its catchment. The ice covered season is important in itself and in setting the stage for the great biological activity of the short spring and summer seasons.

Lakes and lake resources are "consumed" differently in covered and open seasons. For example, terrestrial animals stop taking water from a lake in "winter" but humans may continue to draw on the decreasing unfrozen water body beneath its ice sheet. They may also continue to deposit sewage into it and take fish from it.

Lakes are a means of travel for humans almost year round but in "winter" trucks, tractors and dogteams on over-ice roads replace barges and boats. The use of lakes for travel by terrestrial animals, large and small, increases greatly in the ice-covered season. In the North, many lakes become more, rather than less, accessible in winter as surrounding terrain becomes frozen and snow covered. Indeed, winter road and trail makers seek out lakes, as do travelling terrestrial animals. The compact and shallow snowpacks on the level lake surface are much more conducive to travel than nearby land. The great winter road systems of the Canadian Shield and the Mackenzie Valley, for example, were and are as much "ice" as "snow" roads.

From many points of view, in the North, the freezeup and breakup of a lake are the most dramatic events of its annual cycle. The presence or absence of winter cover symbolizes markedly different relationships between lake and atmosphere. The cover affects the lake's energy balance and circulation patterns in it. These in turn affect photosynthesis and oxygen production in the water and thus all life processes. Breakup of the ice sheet plays its own part in the biological and hydrological impacts of spring melt, including having pronounced effects on lake chemistry and lake shorelines, the latter involving the biologically important littoral zones.

Formation and Nature of the Winter Cover of Lakes

The Role of Temperature and Circulation in Cover Formation

Circulation of water within lakes is very important for a number of reasons, including lake productivity and in the present context, ice formation. Although morphometry and other factors affect individual cases, the northern lakes in our size range usually turn over once, in the high arctic, or twice, in the subarctic, per year. In the latter case, the lake stratifies in summer with warmer water at the top and colder water below. During the fall, heat losses to the atmosphere exceed gains so that water surface temperatures drop. The cold water sinks to be replaced by warmer subsurface water, thus initiating the fall turnover. This continues until the surface water is reduced to 4° C, the temperature of maximum density of water, such water sinks to the bottom of the lake to remain there until the entire column is at 4° C. At this point, further cooling of the surface *lowers* water density so that the cooling layer will remain at the surface until its temperature is reduced to 0° C allowing ice to form. In winter the lake takes on an inverse stratification, 4° C at the bottom and 0° C at the top. This is reversed again come spring. The two turnovers per year case (dimictic) is most common in the Subarctic (Wetzel, 1975, Figure 6-6).

In the high arctic, one turnover, involving the entire, short, ice-free season (monomictic) is more usual. In this case, lakes, particularly shallow lakes, never develop a sufficiently strong thermal stratification to resist wind-induced turnover in summer.

In very cold situations, lake temperatures may never exceed 4° C. Thus these lakes will circulate freely throughout the ice-free season and rapidly lose heat and freeze over once air temperature falls below freezing.

Where lakes are perennially ice covered, a rare situation in the Arctic, they do not benefit from free circulation in contact with the atmosphere (Hendy *et al.*, 1972 and Hobbie, 1984, for Antarctic cases). Circulation of water *under* ice is discussed below.

Freeze up dates in Canada are shown in Allen (1964), Figure 9 (also Canada, 1978, Pl. 19). Average dates of complete cover formation range from 10 December in subarctic locations to 10 September in the high arctic. For comparison, the mean date in Southern Ontario and Quebec is 10-20 December.

Typically ice begins to appear in shallow, sheltered bays and spreads out across the lake (see Adams, 1980a). The first ice to form is usually simply frozen lake water which takes the form of column-shaped crystals, "candles", which grow down into the lake. As this layer is effectively transparent to light it appears dark and is referred to here as "black ice".

It is not unusual for an ice cover to form and re-form several times in the early winter, especially in the case of deep lakes or those with marked currents.

Generally the black ice layer becomes covered with a more or less thick layer of snow which, being itself sublimated water, is properly thought of as a second layer of ice. This snow insulates the underlying water body from the cold atmosphere, slowing black ice growth. It also shields the lake from solar radiation. However, where the snow is heavy enough to depress the black ice below the water level of the lake, cracking will cause part of the snow pack to be flooded Figure 1. The slush so formed freezes from its surface downwards producing a third layer of ice. Being granular, this ice, like snow, reflects a good deal of light and so appears "white". The slushing-refreezing process may occur several times and produce successive layers of "white ice" (Figure 1). In the central and high Arctic where the cold is intense and snowfall is low, black ice dominates with a thin, incomplete, snow cover and rare white ice. In the snowier parts of the subarctic, white ice may dominate with a relatively thick, complete, snow cover.

If the type of middle range lake under discussion here is in a relatively snowy region, its winter cover comprises three more or less thick layers, snow, white ice, and black ice. Peak total ice thickness (excluding snow in this case!) is in the order of 1.4 metres. The range of total ice thickness in arctic and subarctic Canada (Bilello and Bates, 1975) is from 1.0 metre to 2.2 metres (Figure 2). This range would be greater if it were not for the fact that the white ice and black ice growth processes are to an extent compensatory, the formation of white ice offsetting the insulating role of snow.

As snow on lakes is very prone to redistribution by wind, marked spatial patterns in it are normal as are patterns in the white ice produced by snow loading. In subarctic (and temperate) areas the tendency is for white ice and snow to be thicker near the lake margins and thinner towards the centre of the lake with some upwind-downwind differences (Figure 3).

In the spring, the cover removal sequence is snow then white ice and then black ice. A transparent black ice sheet allows radiation through and this heats the underlying water. A small proportion of the radiant energy is absorbed at interfaces of the black ice crystals and warms the ice sheet internally. This causes the sheet to "candle" and disintegrate while it is still thick. By contrast, a cover of snow and/or white ice caps the black ice, reflecting and absorbing radiation, thus keeping the underlying sheet intact. Persistence of snow and white ice thus prolong breakup and affect its character.

Breakup dates in Canada range from 20 May in the subarctic to 1 August in the high Arctic, with rivers breaking up 10-20 days earlier (Allen, 1964) (break-up on lakes in southern Ontario is 10-20 April).

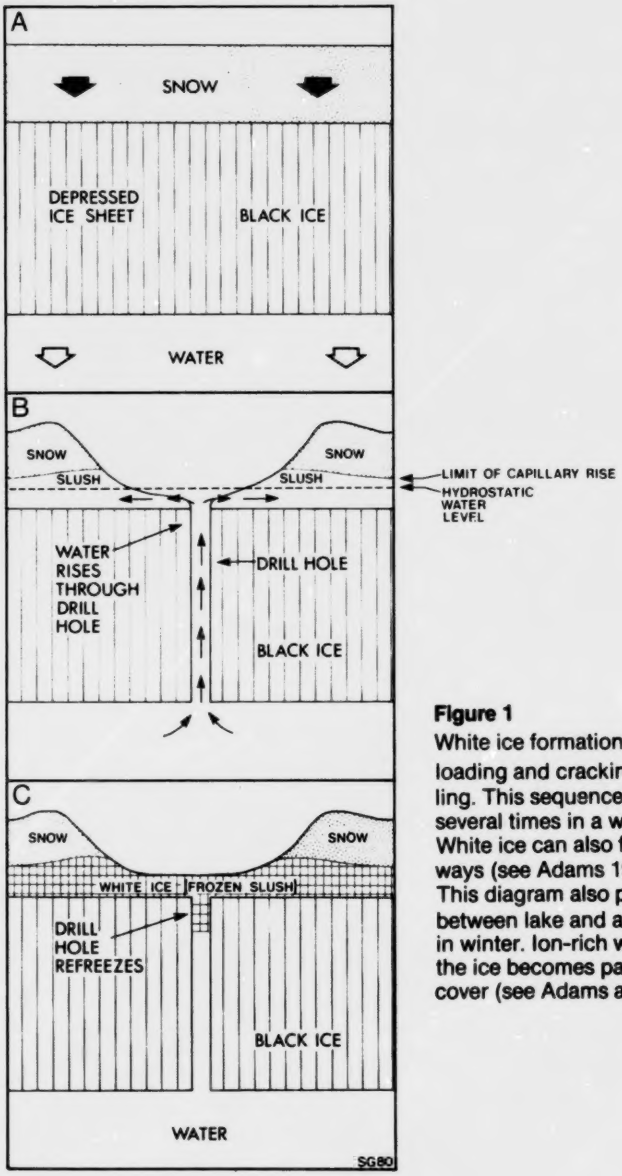

Figure 1
White ice formation following snow loading and cracking or, here, drilling. This sequence may occur several times in a winter or not at all. White ice can also form in other ways (see Adams 1980a, Shaw 1965). This diagram also portrays interaction between lake and atmosphere in winter. Ion-rich water from beneath the ice becomes part of the lake cover (see Adams and Lasenby, 1985).

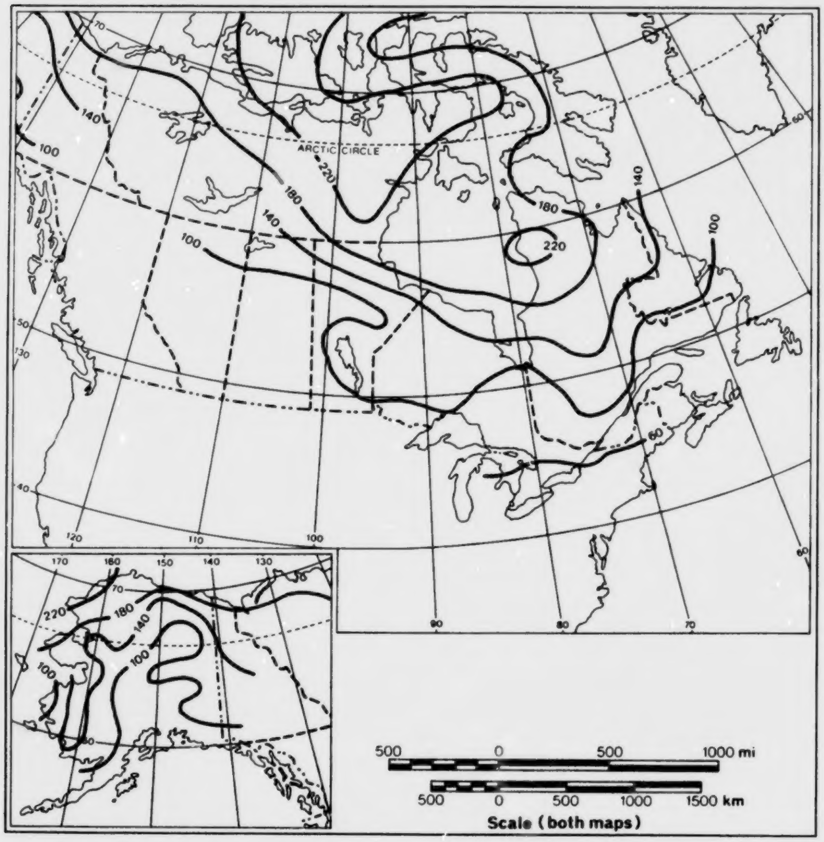

Figure 2 Peak ice thicknesses, 1971-72 (from Bilello and Bates, 1975). These thicknesses (cm.) include cases where the ice sheet is entirely black ice and others where white ice dominates. The former includes the Arctic Island sites, the latter includes the peak east of Hudson Bay (Inoucdjouac). Peak ice is achieved in mid-April in central Quebec-Labrador (ca. 55°N), in early June in the very high Arctic. See also Bilello, 1980.

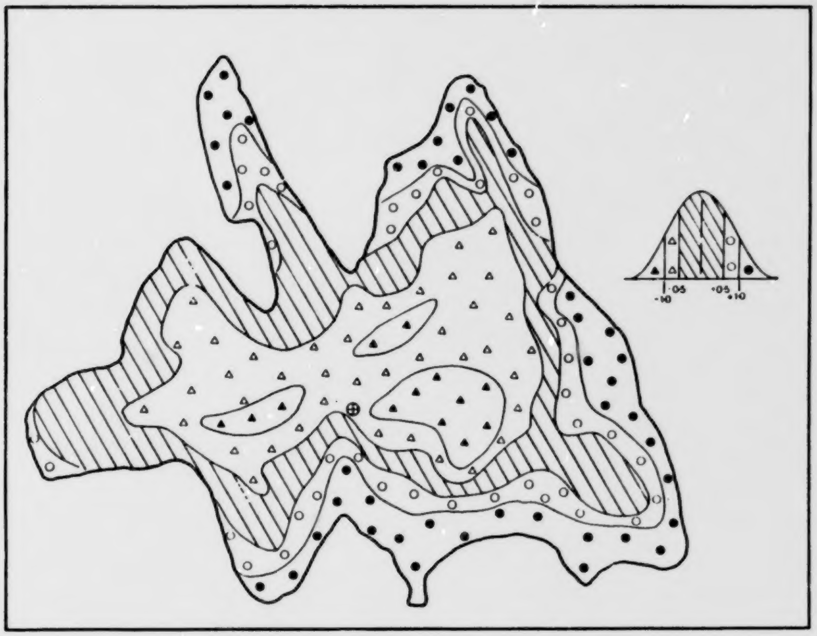

Figure 3 Spatial patterns of white ice thickness on Elizabeth Lake, Labrador (ca. 55°N), mean of three late February surveys, expressed in terms of standard deviations from the mean. The margin (thick) - centre (thin) pattern with an upwind (thin) - downwind (thick) effect is apparent. As snow is an important control of white ice formation, this distribution is a good representation of the general tendency for snow to accumulate in certain patterns on this lake. The pattern of black ice tends to be in reverse of this (see Adams, 1984; Adams and Roulet, 1984).

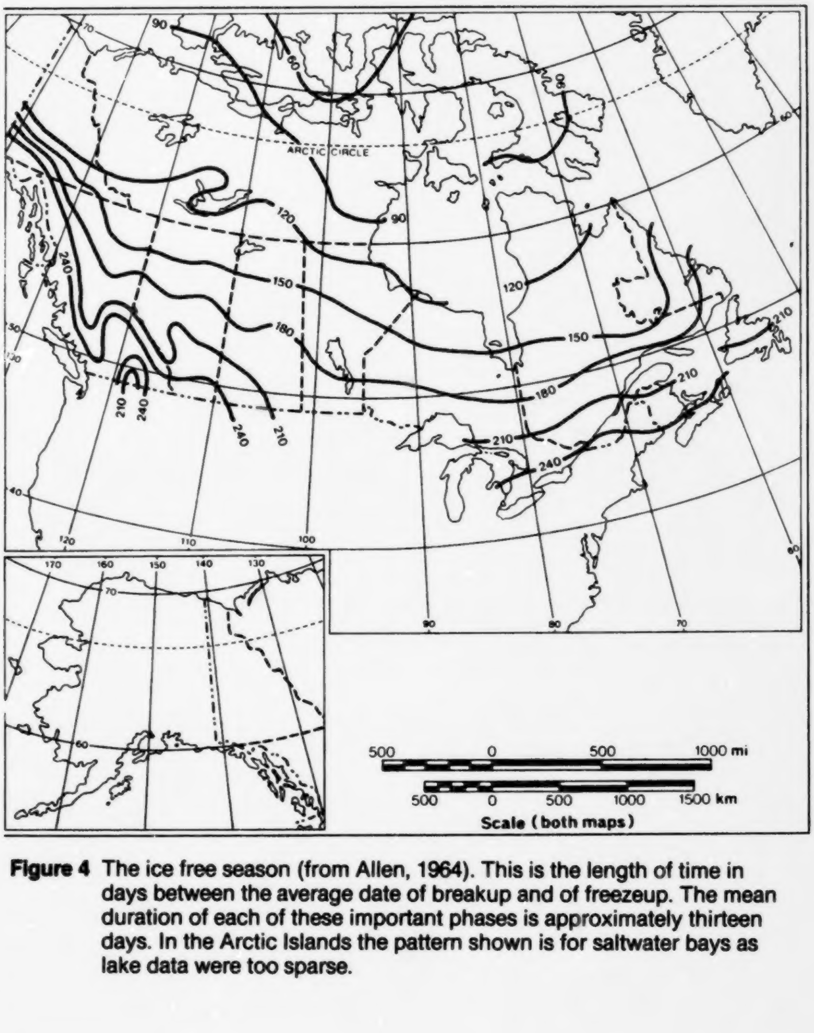

Figure 4 The ice free season (from Allen, 1964). This is the length of time in days between the average date of breakup and of freezeup. The mean duration of each of these important phases is approximately thirteen days. In the Arctic Islands the pattern shown is for saltwater bays as lake data were too sparse.

Breakup is associated with the spring turnover of our lake. The duration of ice cover can be deduced from Figure 4. Michael (1971) offers a comprehensive treatment of ice-forming processes.

Illustrations of Biological and Hydrological Roles of Lake Cover

The formation of an ice sheet, although in one sense simply a stage in the annual energy and mass cycles of the lake, represents a marked change in relations between the lake and the overlying atmosphere. Direct mass exchanges in the form of precipitation, condensation, evaporation, between the unfrozen water body and the atmosphere largely cease and energy exchanges become dominated by the radiation flux through the lake cover, with muted thermal exchanges. Indeed, the main thermal effect of the cold overlying atmosphere in winter is not on water temperature but on the growth or melting of the ice sheet (Bengtsson, 1981). Similarly the role of snow falling on the lake is quite different from that of rain in summer. While rain represents a direct gain to the water body, raising water levels and causing discharge from the lake, snow will displace water from beneath the ice (if the lake outlet is open) but will itself, with its constituent atmospheric chemicals, remain on the lake until spring. Once on the lake, the snow acts as a barrier to radiation and as a layer which insulates the lake from the cold atmosphere.

Ice Cover and Light

The roles of each of the winter cover components with respect to the visible (light) portion of the radiation spectrum are particularly important. Black ice is virtually transparent while snow is relatively opaque, reflecting a good deal of light and absorbing some. White ice is closer to snow than to black ice in terms of its optical characteristics. Thus, given sunlight, a lake covered with only black ice receives much light. Early spring heating in high Arctic lakes and most of the heating of perennially ice-covered Antarctic lakes derives from this source.

On the other hand the water body of a lake covered with snow and white ice may be very dark. Indeed lakes in snowy subarctic regions, at quite low latitudes, may well receive less total solar radiation than lakes in low snow locales north of the Arctic Circle which experience twenty-four hours darkness. This is a very pointed illustration of ice cover controlling lake seasons. Snow is the dominant control of light. Even in the high Arctic, where snowfall is very slight, snow and/or very thin white ice can make a significant different in spring light regimes.

Light from one standpoint, is simply a portion of the radiation balance of the lake; snow and white ice prolong spring melt because they reflect shortwave radiation (Heron, 1985). However light alone is critical for subice photosynthesis which, in the absence of inflows, is *the* source of oxygen and all energy which drives the aquatic biological systems of a water body cut off from the atmosphere by an ice sheet (see Aho, 1978; Jackson and Lasenby, 1982; Mathias and Barica, 1980; Welch, 1974; Welch and Bergman, 1985; Welch and Kalff, 1974; etc.). Oxygen is consumed by respiration and by the breakdown of organic and inorganic materials in the lake. If light levels are low, photosynthesis is hindered and oxygen may be depleted in the water body (Welch and Bergman, 1985 for a treatment of the "sealed" permafrost lake case). In some situations this results in "fish kills" (Barica and Mathias, 1979; Mathias and Barica, 1980; Welch *et al.*, 1976; etc.). At very low light levels, the properties of the particular snow and white ice layers, rather than simply their thickness become important as they selectively filter light allowing some wavelengths through and stopping others. Some wavelengths are more important for photosynthesis than others (Figure 5).

The redistribution of snow on a lake by wind changes the character of the snow concerned. Snow grains are altered during this movement but, more importantly, the temperature regime of the new, generally thin, compact, pack is altered. As it is the temperature regime of a snow pack which controls stratigraphic evolution, this means that the crystallographic development of the snow is changed. A relatively steep temperature gradient is a feature of lake snow pack (Adams *et al.*, in press). This gradient results in the development of "depth hoar", or distinctively large and relatively weak crystals at the base of the pack. As a result a "typical" lake snow pack will have a compact surface crust underlain by a weak layer of coarse crystals (Allan and Adams, in press). On mountain slopes this conditions produces avalanches because the weak underlying snow cannot support the overlying snow load. On lakes it produces the spreading "crump!" sound which often greets skiers on a lake. This distinctive stratigraphy has implications for the snow's role with respect to light (large crystals increase light transmission), insulation, over snow travel, etc. Generally speaking, for example, lakes are less well insulated from the overlying atmosphere than nearby land. Spatial patterns in the ice cover produce spatial patterns in the light regime (Figure 6).

Ice Cover and Chemical Loading

The nature of winter cover is also important with regard to the atmospheric and other chemical loading of lakes. In this context, months of winter precipitation build up on the lake and in its catchment to "re-enter" the hydrologic and biologic system rather dramatically during spring melt. This is often described as a nutrient or pollutant "shock". With regard to the impacts of the lake cover itself, as distinct from the impacts of snow

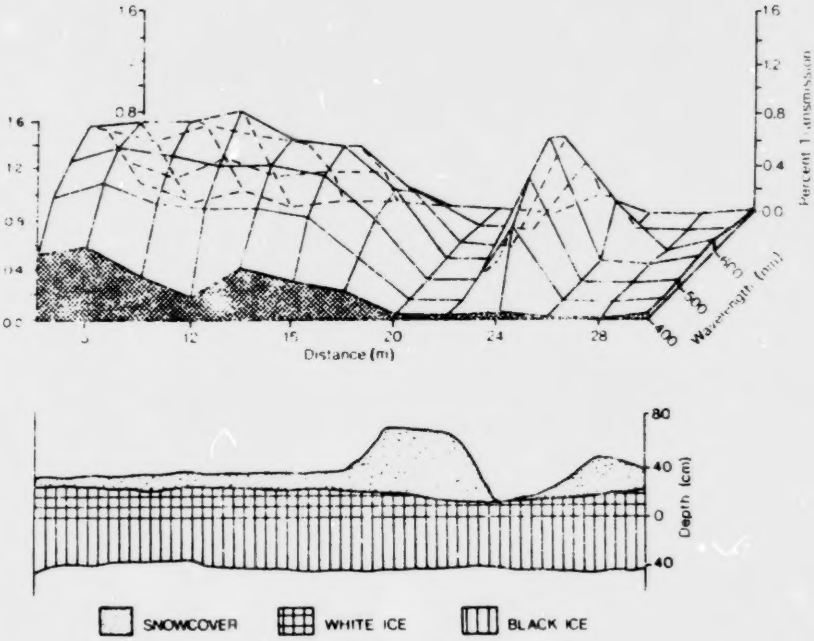

Figure 5 Variation in amount and wavelength of light under a strip of lake cover modified by means of a snow fence. Note the dominant control of snow on light transmission and the variation of transmission across the spectrum. The wavelengths 660 nm and 460 are important for photosynthesis (Adams, W.A. *et al*, 1984).

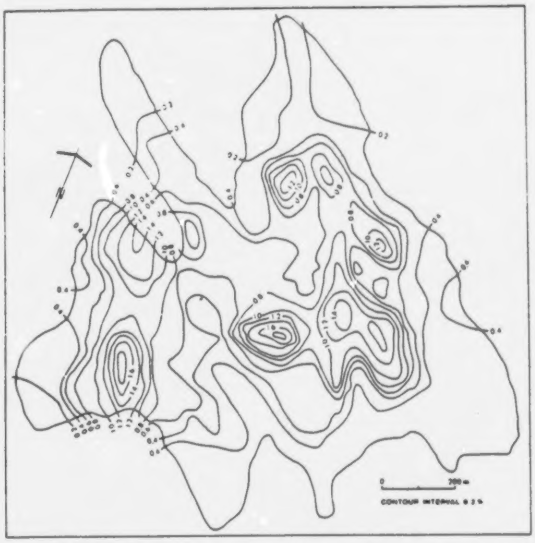

Figure 6 The variation of light (as represented by the 660 nm band) received beneath the ice, including snow cover of Elizabeth Lake, Labrador (ca. 55°N). Note the high receipts in central areas, low around margins (compare with the white ice and snow patterns shown in Figure 3). The 'deep hole' on this lake, a site where limnological measurements tend to be made, is indicated by X. It is clearly not a 'representative' site in terms of light receipts (Roulet and Adams, 1984).

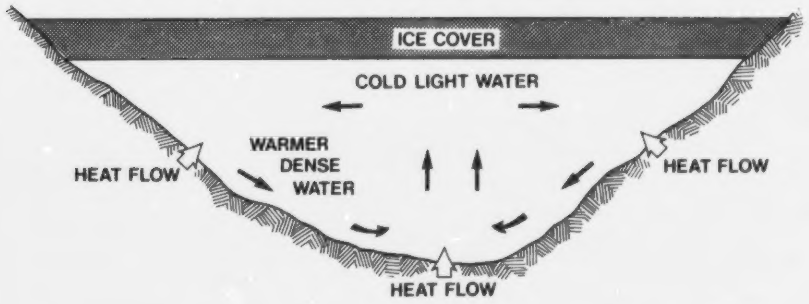

Figure 7 A schematic portrayal of circulation beneath a black ice cover assuming negligible heat gains at the surface (from Bengtsson, 1981). The emphasis here is on the role of water temperature in inducing density currents. In the text, exsolution of ions from the ice is stressed in this regard. Other density-induced patterns can be envisaged. Spring snowmelt, being close to freezing, is light and so tends to remain at the top of the water column just under the ice (see Bergman and Welch, 1985; Welch and Bergman, 1985).

melt from the surrounding land, it is important to be aware of the different roles of the three main lake cover components, snow, black ice and white ice.

In the case shown in Figure 1 the snow represents atmospheric constituents, available to enter the lake in the spring. The black ice is lake water frozen during the winter. As it froze, gases and solids were exsolved into the underlying water, raising the ion concentration in the sub-ice water layer and producing relatively pure, ion-free ice (Adams and Lasenby, 1985; Jones and Ouellet, 1983; Welch, 1974; Welch and Bergman, 1985). In the Arctic, exsolution from black ice into shallow permafrost lakes can produce very high concentrations of ions. Thus, on melting, the relatively pure black ice might well have a diluting effect. By contrast the white ice contains all the atmospheric inputs of the slushed snow from which it was formed *plus* those ions contained in the *enriched* sub-ice water layer which came up through cracks to form the slush. As a result, part of its spring impact is *recycled* ions. Thus each layer has a different chemical impact in the spring so that the proportion of each and the sequence and rate of melt of each are important (Adams, 1980b; Allan and Adams, 1985).

The simple presence of ice also affects the way in which a lake receives chemical inputs from its catchment (see below).

Ice Cover and Lake Circulation

As more work is done on lake winter conditions, it is becoming clear that circulation does occur under an ice cover in the thermally "stratified" water body even where the lake is unaffected by throughput of water (Likens and Ragotskie, 1975; Likens and Hasler, 1984; Bergman and Welch, 1985). The temperature range on which the stratification is based is not great – at most 0-4° C. Sub-ice currents are caused by differences in water density which arise from differential heating or from differences in ion concentration in various parts of the lake. The ice cover may play a role in both of these cases. Under the ice, heat exchange with the atmosphere is effectively confined to the direct effects of radiative exchanges, the effects of conduction are minor. Roles of the various cover components in the radiation balance have already been mentioned. It is clear, for example, that with a spatially variable ice, including snow cover, there will be differences in spring solar heating across a lake with associated differences in the density of the immediate sub-ice water. In this case, heating, i.e. raising the temperature above 0° , implies increasing the density. Heat flow through the lake bottom or from inputs/outputs of water has similar effects. The circulation patterns in Figure 7 are one example of this. The diagram is based on Bengtsson (1981) who suggests velocities in the order of metres per day. While bearing in mind that the diagram is stylized, it is interesting to consider Figure 7 in the context of the effects of centre-margin patterns of snow and white ice described above or of heat absorbed by a marginal moat on the spring temperature regime of permafrost lakes.

Water density differences are also induced by exsolution of ions from the black ice into the underlying water (Adams and Lasenby, 1985; Barica, 1977; Schindler *et al.*, 1974a). Schindler *et al.*, (1974a) appear to have been the first to notice that the resulting build up in ion concentration is not confined to the immediate sub-ice layer but affects the bottom of the lake also. This suggests a circulation of ions. The winter-long pattern shown in Figure 8 is interesting in that it illustrates this effect *and* suggests the white ice forming process has its role too as a mechanism for *reducing* ion concentration immediately below the ice.

The longer a lake is ice covered, the more important are mechanisms which promote sub-ice circulation in preventing complete stagnation and de-oxygenation of layers in lake. The strength of the sub-ice stratification is also important in terms of the impact on the system of spring melt. It is normal for snow melt on land to occur before lake break-up, often weeks, in some cases months, before. The cold, low density, land snowmelt water, with its constituent chemicals, enters the lake and, in the stratified case, passes through it immediately below the ice without mixing with the main lake body. It is clear that, for example, the implications of "acid shock" are very different in this case than where the inputs mix freely with the lake water (Bergman and Welch, 1985; Gunn and Keller, 1985; Stigebrandt, 1978).

In the high arctic particularly the physical presence of the ice sheet controls inputs of snowmelt water as well as the stratification of the lake water column. For a more or less large proportion of the melt season, runoff from the lake's catchment may pass across the lake in a moat formed on top of the ice sheet. In such a case, the melt water and its constituents have no contact with the unfrozen water body at all. The intricacies of snowmelt runoff into lakes from bare, "youthful", permafrost basins and the effects on runoff quality and quantity, of depth of active layer, solifluction, stream channels which are frozen solid, and/or dammed by snow are aspects of hydrology and biogeochemistry which merit a good deal of thought and study in northern limnology (Woo, 1980; Hobbie, 1984). Figure 8 reveals how the evolutionary stages of cover development affect lake chemistry during the winter. The nature of the cover which develops, its duration, and the way in which it melts all affect the chemistry of spring melt.

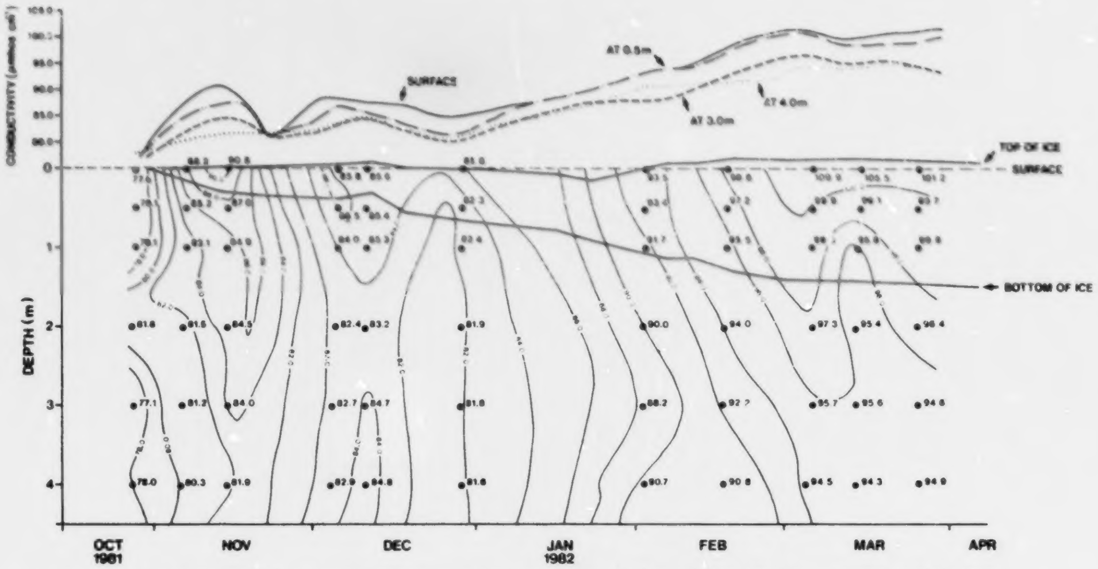

Figure 8 The conductivity regime beneath the ice cover of Knob Lake, Quebec. Conductivity is a measure of the concentration of major ions in the water. Conductivity increases throughout the winter as ions are exsolved from the black ice, this is particularly apparent immediately below the ice sheet. However, periodic losses of ions occur during slushing events and white ice formation. These can be picked up from the plots of conductivity at specific depths inserted on top of this diagram. The pronounced dip in mid-November is a good example. In reading diagrams like this, it should be borne in mind that deeper strata represent much smaller volumes than shallower (Adams and Lasenby, 1985).

Effects of Breakup

The roles of black ice, white ice and snow in the evolution of a lake's winter cover are interrelated in physical and chemical terms. They also have interrelated effects on melting. At the end of the winter, the timing and nature of breakup may strongly affect and may be strongly affected by the prior evolution of the three cover components. For example, thick snow and white ice will prolong breakup with implications for spring loading as outlined above. Snow and white ice will also tend to maintain the ice in the form of floes. These floes can cause littoral and marginal damage as a result of abrasion and ice shove, with great biological, geological (and economic) implications. It is not unusual, for example, for docks, buildings or large trees to be removed by lake ice. An ice sheet which is largely black ice, on the other hand, will break up into candles while it is still quite thick and will cause minimal spring damage. However such black ice sheets, during the winter, being relatively uninsulated from fluctuations of air temperature, are subject to expansion and contraction which may produce mid-winter shoreline damage (Dionne, 1979). A relatively large proportion of the littoral zones of shallow arctic lakes is in contact with the ice sheet. Where the depth is less than 2 metres or so the entire lake floor may be directly affected by ice. This has important implications as benthic (bottom) production greatly exceeds phytoplankton production in arctic lakes.

The shorelines of lakes in permafrost areas are further affected by ice in the banks and beneath the lake. Differential thawing of this ice, with wave and ice action, helps produce the distinctive shape of many arctic lakes. Where there is a pronounced prevailing wind "oriented" lakes of tundra areas such as the North Slope of the Yukon and Alaska are produced, elsewhere they are round (Bird, 1974; French, 1976).

Human Impacts on Ice Sheets

Thus the winter cover of our "model" lake is a more or less complex phenomenon composed of a number of interrelated components. The components develop throughout the winter. The development of one affects that of the others. If, for example, snow is compacted, its insulating properties are reduced, black ice is promoted, perhaps at the expense of white ice. The change in the snow itself, with the related changes in the other cover components, affects the lake's light and chemical regimes, the bearing strength of the ice cover, its trafficability, the nature of spring breakup, and other variables or characteristics. Similarly the drilling of a hole in the cover at a time when there is a slushing potential, reduces the snow pack, promotes white ice growth, limits black ice growth, at least in the short term, results in a loss of ions, including oxygen-rich water, from the lake, and has later implications with regard to such things as ice strengths and breakup.

In the North, except for the relatively short freeze-up and break-up seasons, bearing strength can generally be assumed, so that travel conditions, for humans and animals, are largely determined by snow and slush conditions. Figure 9 is an attempt to show, schematically, the ramifications of a single ski or snowmobile trail across a small lake in a snowy environment. In this case a more or less regularly used trail is envisaged, but those who use lakes in winter may well have noticed that it is sometimes possible, months later, to identify an old single ski-trail as it melts out from beneath the snow. In this case, the characteristic lake snow stratigraphy is compacted into a thin layer forming a strip across the lake. Beneath the trail there is a thickening of black ice and a relative thinning of white ice where it occurs. The compaction of the snow also produces a strip of persistent snow across the centre of the lake which in this case is often effectively snow-free. The strip formed by the trail acts as a windbreak, extending snow cover over a large central area of the lake which would otherwise have often been snow free. This affects the light regime and the ice growth regime throughout that area. Cracking produces white ice in the pattern shown in the diagram, the spread of slush being controlled by the track ridge. This change in pattern of snow cover and ice growth throughout the winter may well affect the pattern of breakup. Thus the one change, a single trail, is conceived as having local and lake-wide ramifications. (A quilt-like pattern of slush and white ice has been observed on lakes criss crossed by snowmobile trails. A single track was chosen here for diagrammatic purposes.)

It is not difficult to imagine that travel and drilling associated with commercial or recreational ice fishing could have even more dramatic impacts on lake winter cover. It will be realized that the impact of "real" winter roads, which involve large scale compaction of snow by rollers, the pumping of water onto a lake surface and other cover modifications will have even more marked effects. Such changes will, for example, affect the winter and spring light regimes of lakes concerned and the duration and character of the break up season.

Another example of human lake use in winter is the use of lakes as receptacles for the disposal of sewage (Boyd, 1959; Boyd and Boyd, 1963; Drake and Freund, 1980; Eisenhower and Bridger, in press). It is interesting to note that arctic lakes do respond markedly to nutrient enrichment (Kalff and Welch, 1974; Schindler *et al.*, 1974b; Welch, 1974). Let us consider this with respect to the "unique" thermokarst lakes.

Thermokarst lakes are shallow and characteristic of large areas of the continuous permafrost zone. Being shallow, they are underlain by permafrost and may well freeze virtually solid at some point in the year. Lakes

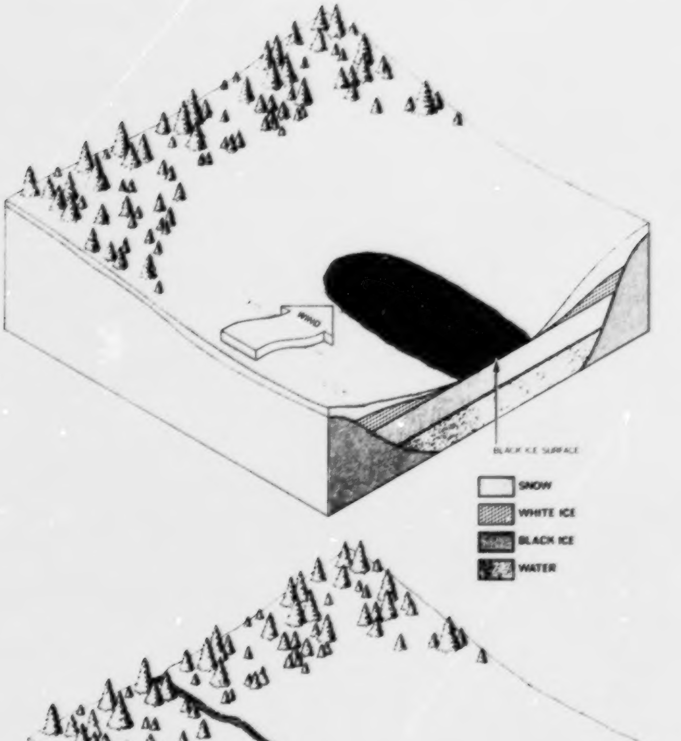

Figure 9 Schematic representation of possible effects of a single snowmobile trail, perpendicular to the prevailing wind, across a lake. The late winter condition of a lake like that in Figures 3 and 5 is envisaged. 9a is before, 9b is after. Various dimensions are, of course, exaggerated (see text). It is assumed in this case that the centre of the lake, normally a thin white ice location, had no white ice at all.

which freeze solid or virtually solid do not contain fish in winter but they may be valuable for fish-farming in summer. This is the case in prairie ponds which have an annual cycle which is analogous to that of arctic ponds (Barica, 1975; Barica *et al.* 1980). Also, being underlain by permafrost, they may be neither recharge nor discharge areas for groundwater (Mackay and Loken, 1974). The addition of sewage to such a lake will affect its thermal regime and thus, among other things, its shape. The breakdown of sewage will be affected by the nature and duration of the ice-cover involving all of the ramifications on light, photosynthesis, sub-ice chemistry and other features of the sub-ice regime. "Management" of the ice cover should be a critical feature of the design of such a sewage disposal system. Similarly, management of ice on an arctic reservoir, for example through control of snowcover, can affect the amount and quality of water in it.

Concluding Remarks

One can think of arctic limnology in general as focussing on the earliest stages of lake system development. The research opportunities here are real as a range of ages is present, generally young in the last centres of glaciation, generally less young towards the limits of glaciation. Lakes on the flights of raised shorelines, extending upward from the present shore in isostatically active coastal areas, are a particularly good example of this scope for study of early stages of lake development. At the lower levels are very new lakes which are in the process of being cut off from the sea, still relatively saline, some still visited by seals and other marine life. At the upper levels are older lakes which were cut off from the sea thousands of years ago. These flights of raised shorelines, of course, provide similar opportunities for the study of series of terrestrial ecosystems.

Although high altitude lakes at all latitudes are evolving in the presence of ice, nowhere is ice so significantly a part of lake systems as in polar regions. The arctic lakes provide special opportunities for study of the roles of the solid phase of water in limnology.

Balanced use of arctic lake systems can only be achieved with a clear understanding of their nature, including the nature of their winter cover. At the present time, although general principles are known, there is still a great need for further study as the number and diversity of lakes in the North are enormous.

Fox *et al.* (1979), after a review of literature for lakes *north of 40° N*, state that existing general lake models cannot describe lake processes during winter and spring ice conditions and that:

> northern and subarctic lake modelling efforts are plagued by many of the same problems as temperate lakes (and by) more severe climatic conditions, greater sparsity of data, lower concentrations of biota and chemical constituents, and few known results of lake management.

It is not unreasonable to say that the magnitude of these problems increases as one goes north becoming very serious in the Yukon and NWT. Despite great efforts by several workers in recent years, the lakes of the huge land areas which these Territories represent are still remarkably unknown. A basic first step in any conservation or management strategy for northern lakes should be to design long term research and monitoring programs which will provide an adequate information base. These programs must encompass the ice covered season.

The study of latitudinal gradients of species diversity has attracted ecologists for many decades, especially those interested in the terrestrial environment. This is a good example of an aspect of science in which the Arctic becomes of special interest as one limit of a spectrum extending from Equator to Pole. Pianka (1966) presents a very interesting overview of this topic, considering six broad hypotheses for patterns of species diversity and suggesting tests for each. This paper and its references should be of great interest to those interested in understanding and monitoring arctic environments for heritage purposes. The paper provides a meaningful frame of reference for long and short term studies at the macro and micro scale. In the case of lakes, it appears likely that latitudinal gradients of species diversity are less apparent (Pianka, 1966, 34). The relative isolation of the lake systems from latitudinal control, such as light, may well be one reason for this.

Studies of relationships between, for example, the "stage" of development of lake communities and the stage of adjacent terrestrial communities, in the Arctic, might prove extremely valuable for the understanding of both Arctic and non-Arctic ecosystems. Such studies might also provide a useful frame of reference for landscape management as they would require understanding of the entire physical and biological system of a lake and its catchment. As Likens and Bormann (1974) put it "The key to wise management of aquatic systems is wise management of watersheds or landscapes". They might easily (see, for example, their Figure 1) have neatly turned this assertion to point out also that wise management of aquatic systems is a key to the wise management of landscapes.

As for selecting particular subarctic and arctic lake systems for special "heritage" attention before the full range of their characteristics is appreciated, it should be noted that lakes already appear in areas "designated" for various purposes. In some regions, lakes are so numerous that any selected tract of land contains them, in others, where lakes are rare, they tend to be a focus for terrestrial, including human, systems and so fall within designated areas. The Auyittuq National Park on Baffin Island or the proposed National Park on Ellesmere Island, for example, both contain lakes. However, it is important to realize that, in such cases, lakes are rarely designated for their own sake.

It is interesting to look at a volume like Nettleship and Smith (1975), which lists 71 biologically important areas in the Canadian North, in the light of this need for lake research. While lakes are present in the majority of sites selected, they are rarely stressed in the site descriptions and often are not mentioned at all, in site selection rationale, even where a lake appears in the title of the site Table 1. This reflects the fact that often the lakes are taken for granted as a natural focus for the phenomena which were of interest to the IBP site selection group. It also reflects a tendency for fish biologists to study biota at the expense of the physical environment of lakes and for limnologists to ignore fish (Rigler, 1982)! In this case too it reflects a lack of even the most basic information about arctic lakes.

In the absence of a proper lake information base, the Nettleship and Smith 1975 sites and *the thought that lakes merit attention in their own right* provide a good start for the selection of lake systems which should be designated for seasonal or year round attention as special or typical benchmark or monitoring sites of various kinds (Smith *et al.*, this volume; Theberge *et al.*, 1980).

Table 1 contains some comments on this. The case of lakes which are "special" is in some ways easier than that of "typical" lakes. It is clear now for example that Lake Hazen, Ogac Lake (Table 1), Netilling (seals), and the lakes downwind of Smoking Hills near Cape Bathurst (exposed to thousands of years of acidification, see Bruemner, 1985) are "special". It is less clear which lakes might best be designated as being important because they have been "developed" in some way but the early studies on Meretta Lake (the sewage lake for Resolute,) (Kalff and Welch, 1974; Schindler *et al.*, 1974b) and work on lakes near larger settlements such as Yellowknife, Inuvik and Frobisher (Brunskill, in press; Henry *et al.*, in press) provide a useful start. Eisenhower and Bridger, 1985 contains work on arctic sewage lagoons.

Ideally a component of any systematic study of arctic and subarctic lakes should be the careful monitoring of suites of varied lakes in a given region. Models for this are provided by the Experimental Lakes, Dorset Lakes and Turkey Lakes areas on the Canadian Shield in Ontario.

Since the IBP (1964-74) there has been only slight progress towards the special designation of selected Ecological Sites for conservation or scientific purposes. The designation of Polar Bear Pass as an Ecological Reserve is the exception rather than the rule (Taschereau, 1985). It may be that the formal inclusion of limnological considerations may add weight to the argument for such designations.

Table 1

Lakes in Ecological Sites of Northern Canada: Selected Examples

The IBP Committee whose work is represented by Nettleship and Smith (1975), the source of information for this table, were interested in terrestrial ecosystems although, in some instances, they do mention limnological phenomena. The purpose of this table is to draw attention to this IBP Ecological Sites list as a useful starting point for the selection of lakes for conservations and scientific designation. As more limnological data become available it will be possible to undertake a more systematic selection. The Ecological Sites are useful because they "cover" the Canadian North reasonably well, because they tend to be locations for which information is already available. Cape Sparbo - Truelove Lowland (see Bliss, 1977) is an excellent example of this as are Lake Hazen and Expedition Fiord. The list does not include sites which have been greatly affected by recent human occupance which are, of course of interest in terms of heritage.

Site (page)	*Commentary in reference (this author's comments)*
Stanwell-Fletcher Lake, Somerset Island (23)	Char and Inuit use cited**
Lake Hazen, Ellesmere Island (63)	Char cited (the site does not encompass the entire lake which is the largest north of the Circle and which has glacier ice calving into it)
Cape Sparbo, Devon Island (79)	Series of char lakes cited (this is an excellent example of a valuable base for limnological research on "typical" water bodies)
Expedition Fiord, Axel Heiberg Island (93)	Sulphur springs cited but not lakes (this area contains 125+ ice dammed lakes, one relatively old landlocked lakes and two ponds)
Chain of Three Lakes, Axel Heiberg Island (115)	The Three Lakes and Buchanan Lake are cited (the chain provides an interesting series (see text), Buchanan Lake, presumably of fiord origin, is potentially very interesting)

Shoran Lake, Banks Island (135)	The lake cited in passing (there appear to be a variety of lakes in this area)
Minto Inlet, Victoria Island (145)	Lakes cited in passing (good example of large number of Sites which have many lakes)
Canoe Lake, Richardson Mountains (162)	Lakes cited in passing (a sample of an unglaciated lake?)
Anderson River (167)	"Numerous lakes and ponds" cited (partly unglaciated?, straddles the treeline, thermokarst and delta water bodies)
Toker Point (175)	"Many lakes and ponds" cited (classic pingo region with variety of ground ice - delta water bodies)
Bathurst Inlet (179)	Lakes not mentioned (another example of lakes, which form a very high proportion of the landscape, being ignored)
Thelon River (183)	Abundant lakes cited (part of a major lakes area of Canada, in Keewatin all Sites inevitably have many lakes)
Kaminuriak Lake Area (213)	The lake is used only to designate the area, "numerous lakes" cited
Ennadai Lake, Keewatin District (225)	Lake cited as remnant of a glacial lake (long term meteorological record available, variety of vegetation types in the catchment)
Baralzon Lake, Keewatin District (229)	The lake is used to designate the area which includes part of it (tundra/ spruce transition)
Twin Islands, James Bay (245)	"Numerous ponds and lakes" cited (a very special "Arctic" location)
Ogac Lake, Baffin Island (284)	The lake's saline bottom layers with their unique population of Atlantic cod are stressed (good example of marine-freshwater transition)

Great Plain of Koukdjuak, Baffin Island (301)	"Water logged with many circular ponds" (characteristic of many areas in the Arctic)

* Nettleship and Smith, 1975
** "Cited" here means that little else is said about the lakes in the published descriptions

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The Significance of Terrestrial and Marine Oases in the High Arctic

V.G. Thomas
S.D. MacDonald

The Canadian High Arctic is a polar desert, with plant and animal life concentrated at terrestrial 'oases' where persistent fresh water drives life processes (Bliss, 1977). However, the majority of animal life in the high arctic is marine, and where fresh water meets salt water at particular areas at the land-sea interface, animal life also flourishes.

The area of the high arctic land mass represented by oases is very small, making them of disproportionately great importance to wildlife and the Inuit. Plant growth and reproduction at these sites is regulated largely by the equilibrium between ice and water. The annual productivity of the terrestrial oases is low, and animals must move about continually to meet their yearly nutritional requirements. Consequently, animal movements allow regrowth of vegetation. The small amount of plant growth produced during the short summer sustains both resident and migratory herbivores and nourishes the resident species during the prolonged winter season. Muskoxen (*Ovibos moschatus*), Peary caribou (*Rangifer tarandus pearyi*), arctic hares (*Lepus timidus*), lemmings (*Dicrostonyx torquatus*) and rock ptarmigan (*Lagopus mutus*) all show a marked dependency upon one species, arctic willow (*Salix arctica*), as their principal food. These facts should be heeded when proposals are made to protect the flora and fauna of such oasis areas.

Of the 27 high arctic sites of major ecological importance identified by the International Biological Programme (Nettleship and Smith, 1975), only one, Polar Bear Pass, Bathurst Island, has protected status to date. However that status was not easily or quickly accorded. Any area subject to protection should be sufficiently large to contain adequate productive oases and should allow animals to move freely among adjacent oases (DIAND, 1981).

The northern Arctic Sea is much less productive than its antarctic counterpart (Smith and Nelson, 1985), and this has implications for its marine mammal and seabird populations. Whereas marine polynyas may be important feeding sites for marine mammals and seabirds during late winter and spring (Stirling *et al.*, 1981; Brown and Nettleship, 1981), the productive coastal zones probably assume that role in the mid-late summer when melt water runoff becomes significant. Marine mammals and seabirds are often found together in large concentrations during the arctic summer, predominantly at the interface of land, sea and glaciers, or river inlets (McLaren and Renaud, 1982).

We hypothesize that at glacier-sea and river-sea junctions, it is the infusion of fresh water which ultimately leads to the great increases in marine food production. Melting of ice fields and glaciers carries nutrients such as nitrates, sulfates, and phosphates, derived from atmospheric precipitation and glacial erosion of bedrock, to the sea. This freshwater influx enriches the local sea and probably brings deeper-water nutrients to the sea surface. There they are incorporated into photosynthetic organisms which, in turn, augment the production of other marine foods. Presumably seabirds and marine mammals are thus attracted to such localized zones to feed. In this sense fresh water runoff may drive coastal marine life process in much the same way as it directs high arctic terrestrial biology.

The unpredictability of the high arctic climate is an inherent, dominant feature of this environment which is immediately apparent in biological processes. The amount of biological production that can occur is affected by two principal factors; the amount of winter snowfall and the intensity of sunshine producing melt during the following summer. These factors interact to determine the amount of fresh water available for biological processes, both on land and in the sea. Temperature also alters the rate at which these processes occur. In the same way that annual differences in the amount of biological growth and productivity can be demonstrated at terrestrial sites, variation in the amount of marine plankton produced is to be expected among years. Attempts to manage high arctic terrestrial and coastal environments must recognize these climatic vagaries and be sensitive to their implications. The same statement should also be applied to harvest quotas for terrestrial and marine animal populations inhabiting mid-arctic and sub-arctic environments.

The definable, productive high arctic terrestrial and coastal zones (Nettleship and Smith, 1975) support the breeding activities of diverse migratory bird species. Furthermore, migratory marine mammals (e.g. harp seals, *Pagophilus groenlandicus* and hooded seals, *Cystophora cristata*), which breed in the subarctic environment visit high arctic waters to complete the growth of their young and build up nutrient reserves to be used in subsequent reproduction (Sergeant, 1973; Thomas and Lavigne, 1984). Thus these high arctic ecosystems cannot be considered to operate in isolation. Rather they are dynamic components of a greater global system.

The distribution of the aboriginal Dorset, Thule and Inuit Cultures can be ultimately linked to persistent productive regions. In this sense, animal ecology is a key to understanding archaeology. These cultures' evolution at the land-sea interface reflects important local concentrations of biological activity. Presumably the Inuit, in turn, were regulated by it. However, today, marked population growth of the Inuit and an infusion of modern technology is producing a situation where native and non-native people may be reducing the population size of some indigenous species.

The present and future significance of high arctic oases to society is multifold. They are of extreme importance to the biological study of post-glacial colonization and adaptation to unaltered habitats of extreme fluctuation and low productivity. Since high arctic ecosystems are apparently among the least complex in nature, they are excellent bases for ecological modelling. However, these same attributes may render them susceptible to human perturbations, since recovery is severely limited by low temperatures, low nutrient supply and time.

With respect to the establishment of land and marine parks, the oases satisfy many of the criteria needed to invoke their permanent protection as National Heritage Sites. The Inuit's cultural relationships with the Arctic have traditionally occurred at these sites and continuation of those relationships is contingent upon the preservation of oases. While recent North Americans view these areas from an ecological, resource, recreational and conservation perspective, their significance to its native people surpasses those bounds. Perhaps, because oases have been the core of life in an arctic desert for so long they have a vital, etherial quality which defies quantification. This permeates all Inuit art and folklore and the works of southern artists who depict high arctic environments. For that cerebral reason alone the oasis regions should be protected for everyone.

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Plates

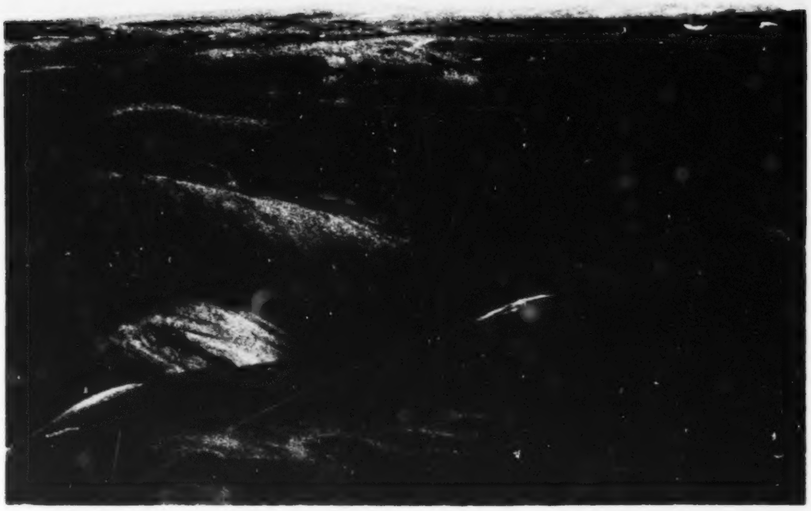

Plate 1 Eroded desert landscapes characterize much of the Canadian high arctic. Ellesmere Island, south of Bauman Fiord.

Plate 2 Fresh water runoff from the Devon Ice Cap and snow melt persist at the coastal plain of Truelove Lowland. The profusion of vegetation makes this a major oasis of prime ecological importance in the high arctic.

Plate 3 Prostrate arctic willow *(Salix arctica)*, whose leaves, buds and catkins provide the major food item of resident high arctic herbivores throughout the year.

Plate 4 An adult female arctic hare *(Lepus timidus)* feeding on purple saxifrage *(Saxifraga oppositifolia)* blossoms at Polar Bear Pass, Bathurst Island. This constitutes her principal food while lactating.

Plate 5 Marine mammals and seabirds concentrate to feed at the junction of glaciers with the sea, especially the glaciers flowing from the Devon Ice Cap into Jones Sound, Lancaster Sound and Baffin Bay.

Plate 6 Northern fulmars *(Fulmarus glacialis)* migrate to the coastal land forms to breed, and derive all of their food from productive localities of the Arctic Ocean.

Plate 7 Herds of Walrus *(Odobenus rosmarus)* congregate at shallow coastal waters to exploit marine invertebrate production.

The Natural Realm in the Arctic: A Critique from a Developmental Perspective

H.M. French

Introduction

The intent of this paper is to assess the significance of our current understanding of the physical environment of Canada's Arctic within a context of assumed economic development of that area. A second objective is to illustrate the degree to which certain geotechnical problems associated with northern development have been solved. At least two perspectives, raised by several of the earlier presentations, will be highlighted. These are (a) the belief that in the longrun, it is probably more difficult to restrict industrial activities in the Arctic than those of tourism and the local inhabitants (Wielgolaski, this volume), and (b) the often conflicting opinions concerning the "sensitivity" of the physical environment of the Arctic, and its variable ability to withstand "stress."

Development Issues

There is no doubt that natural resources development, especially that of hydrocarbons but also including iron ore, copper and zinc, will be the major "stress" imposed upon northern Canada in the next thirty years. The recent completion of the Norman Wells Pipeline, by Interprovincial Pipelines Limited, the current oil and gas exploration activity in the Beaufort Sea by PetroCanada, Dome, Gulf and Esso, and the initiation of the export of limited quantities of crude oil from Bent Horn, Cameron Island, by Panarctic Oils Ltd., all point to the conclusion that the economic development of northern Canada's non-renewable resources is inevitable. As such, it is imperative that the nature of the physical environment be fully understood if rational economic development is to proceed with a minimum of environmental impact.

One problem which complicates the adoption of any one preservation strategy is that the sensitivity of the arctic environment to an imposed stress, or stresses, is difficult to determine. On one hand, as the still-visible remains of the early coal mining activities on Spitzbergen illustrate, the impact of man's industrial activities in the Arctic, once initiated, is not easy to erase. This led to the belief in the late 1960s and early 1970s that the arctic environment is highly sensitive, possessing a slow "recovery" rate. Numerous papers published at that time are concerned with damage and/or change to the tundra vegetational assemblages and faunal populations (Bliss and Wein, 1972; Bliss and Peterson, 1975; Kerfoot, 1972). On the other hand, it can be demonstrated that the coal wastes of Spitzbergen are now being recolonized by native plant species and the landscape is showing signs of recovery. Many Canadian examples can also be cited which illustrate the same phenomena. Revegetation can be mentioned of old mine tailings in the Klondike District, and regrowth of the northern forest cover in the last 60-70 years in areas where trees were removed for fuel, agriculture, mining and other purposes, or destroyed by fire (Rowe, *et al.*, 1975). In the High Arctic islands, the rehabilitation of old wellsites by natural revegetation appears more effective than man-induced seeding and recolonization (French, 1980). Man's activities in northern regions may eventually increase biological productivity, as shown by the impact of seismic lines upon animal movement patterns in the Mackenzie Valley and Delta (Westworth, 1977), and the creation of new habitats at disturbance sites.

Examples and case histories are not conclusive, however, since technological advances mean that the degree of stress is always changing. The changes in drilling mud composition, with the progressive elimination of many of the heavy metals commonly used in the 1970s, is one example of changing technology forcing a re-evaluation of its significance vis-a-vis the arctic environment (French, in press). Likewise, the introduction of cross-tundra vehicles equipped with low pressure balloon tires in the early 1970s significantly decreased the level of terrain disturbance associated with seismic and other operations (French, 1978; Kerfoot, 1972).

It is within this context of current exploration activity in northern Canada, the changing technology, the longer term trend towards development, and a changing attitude towards the sensitivity of the natural environment of the Arctic that the papers presented in this symposium must be evaluated.

Present Knowledge

The papers presented at this symposium represent one of the few attempts to update the excellent synthesis prepared by F.K. Hare thirteen years ago (Hare, 1972). Several general conclusions can be drawn from the papers.

First, there is a lack of data for many aspects of the natural environment of the Arctic. For example, the whole question of cold climate (i.e. cryogenic) weathering has been raised as being fundamental to landscape evolution in arctic regions (Bird, this volume). Equally, animal population dynamics remain a mystery for many species, and areas, of the Arctic (Cooch *et al.*, this volume).

Second, the complexity of the arctic environment must be recognized. The landscapes of the Arctic are highly variable, depending on geology, relief, and weathering processes, many of which are site-specific. Likewise, the vegetation and plant assemblages of arctic Canada vary widely from boreal forest, tundra, and shrub tundra to polar desert and semi-desert. Thus, no one set of environmental guidelines can hope to cover all the different arctic environments which exist in Canada's North. Each environment may possess a differing degree of sensitivity to a given impact or "stress."

Third, notwithstanding the preceding paragraph, current knowledge suggests that the arctic environment is certainly more sensitive in some respects than non-arctic environments. For example, the sensitivity of the arctic environment to climatic change, such as global warming, consequent upon changes in CO_2 levels in the atmosphere (LeDrew, this volume), and the thawing of permafrost associated with such a regional climatic change, make the arctic environments highly sensitive. In all probability, climatic change impacts will present the most fundamental problems for the natural environment of the Arctic in the next fifty years.

Finally, an integrated approach to the study of the arctic environment is required in which all elements are examined and their interactions identified. A systems approach must be championed and interdisciplinary projects encouraged.

Geotechnical Responses

It is easy to dwell upon the negative aspects of northern development and, in particular, either upon the potential impacts, both physical and social, or lack of environmental baseline data. A more pragmatic approach is to emphasize the ability of man to minimize stress, by designing structures or procedures which accommodate or utilize aspects of the physical environment, and man's ever-increasing acquisition of data and field experience upon which to formulate development strategies. Two geotechnical examples illustrate such an approach.

Frost Heave Problems

Because of its relevance to current engineering and resource development concerns in North America, frost heave is an area of priority research in both the United States and Canada.

Frost heave causes problems in the construction of roads, buildings, bridges, and other structures in cold environments. These are relatively well documented in the geotechnical literature (Ferrians, *et al.*, 1969; Johnston, 1980).

Here attention is focussed upon bridges and pipelines. A particularly difficult problem in North America has been the construction of bridges and river crossings. Early structures used piles which frequently heaved in the seasonally frozen zone adjacent to the bank. Modern engineering design attempts, wherever possible, to eliminate bridge pilings. For example, the recently completed bridge over the Eagle River on the Dempster Highway, northern Yukon, consists of a single steel span, 30 metres long (Figure 1).

Nowhere has the frost heave problem been more critical than in the design and construction of chilled gas pipelines in arctic regions. Since they will operate at sub-zero temperatures, water and vapour will migrate towards the pipe. A "frost-bulb" will form and ice lensing will develop, leading to upward heave around the pipe. This becomes critical if the pipe were to pass through areas of discontinuous permafrost since the possibility exists for long continued frost heave around the pipe leading to the eventual rupture.

In an attempt to find solutions to these problems, a number of natural scale experimental projects have been initiated to study the behaviour of soil around a buried refrigerated pipe. At Fairbanks, Alaska, a sophisticated frost heave test facility has been constructed by Northwest Alaskan Pipelines (Figure 2). The site possesses areas of both frozen and unfrozen terrain and a 1.2 metre diameter pipe circulates cold air through a series of different pipe-burial modes. Results from this facility are not yet public knowledge. An earlier test facility, constructed in 1974 at Calgary, Alberta, is currently operated by Foothills Pipeline and the Federal Government of Canada. In this facility, air is recirculated at -10° C and various insulation and burial modes are being monitored. Results indicate that since 1974, the pipe has heaved more than 60 centimetres and that frost depths have penetrated at least 3 metres beneath the pipe. A third facility has recently been completed at Caen, France. A non-insulated pipe has been installed in initially unfrozen soil with a lateral transition from a frost-susceptible silt to a non-frost-susceptible sand, thereby simulating a major boundary of soil types common in permafrost terrain. A first freezing experiment was conducted in 1983 with the pipe refrigeration at -2° C and the chamber air temperature at -7° C. During this experiment the

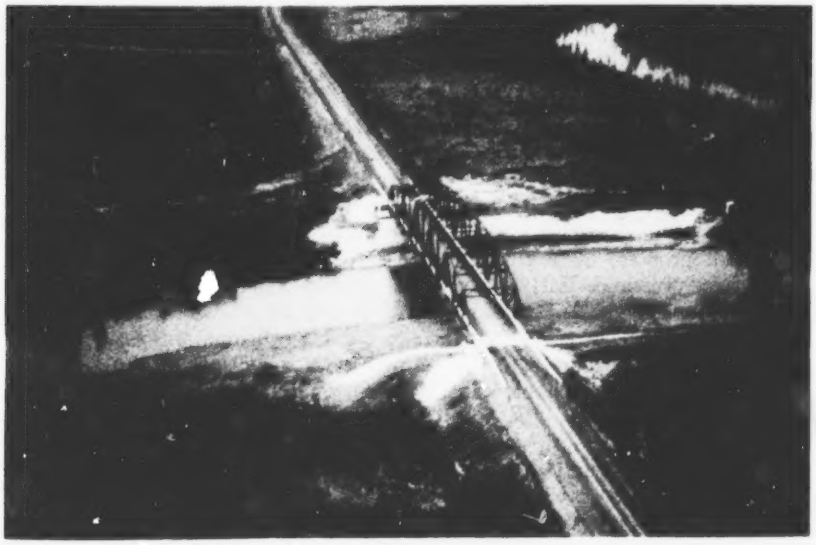

Figure 1 Recent Bridge over Eagle River, Dempster Highway

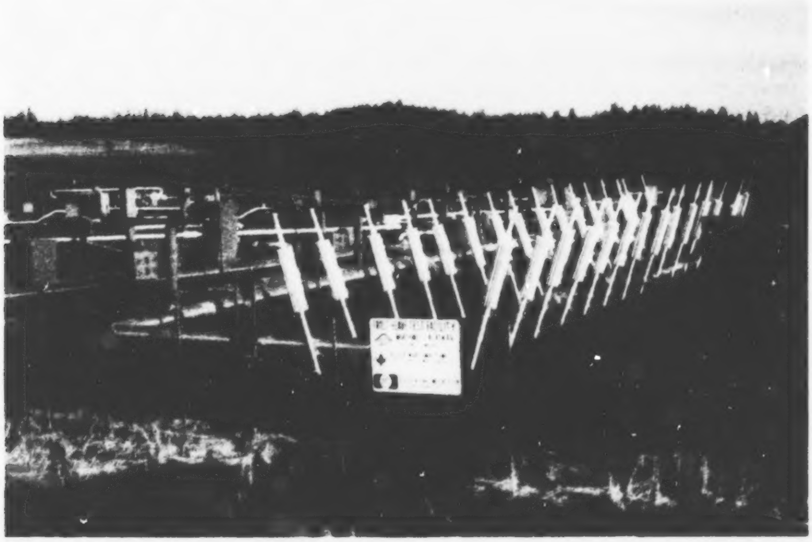

Figure 2 Frost Heave Test Facility, Alaska

pipe heaved 16 centimetres over the 16 metre long test section and the frost line penetrated to 45 centimetres beneath the pipe in the sand and to 30 centimetres beneath the pipe in the silt (Burgess, 1985).

Experiments such as these represent the first steps towards a better understanding of the nature and magnitude of the frost heave problem.

Terrain Disturbance

Our understanding of the consequences of terrain disturbance in arctic Canada has increased significantly in recent years. In nearly all instances, the necessity of maintaining the thermal regime of the permafrost has been recognized and measures to prevent thermal change widely adopted. At the same time, the documentation of case histories of disturbance enable the nature and speed of man-induced thermokarst to be determined and the time period necessary for stabilization to be assessed.

Without doubt, the most common cause of man-induced thermokarst on a large scale is the clearance of the surface vegetation for agricultural or construction purposes. A distinctive hummocky microrelief results from the general subsidence of the ground combined with the preferential melt ice-wedges (Figure 3). A classic example has been described from the Fairbanks region of Alaska where extensive areas were cleared for agriculture in the 1920s. The following thirty years saw the formation of mounds and depressions in the fields (Péwé, 1954).

Recent studies in arctic Canada (French, 1975; 1978) provide some insight into the speed at which man-induced thermokarst develops and the time period over which such terrain remains unstable. They suggest that the thermokarst processes are rapid and that stabilization begins ten to fifteen years after the initial disturbance and probably is complete within thirty to forty years.

A second major cause of man-induced thermokarst relates to the movement of vehicles over arctic tundra terrain. If this occurs in summer when the surface is soft and wet, vegetation can be destroyed and deep trenching and rutting can occur. Probably the worst examples of this sort of activity exist on the Alaskan North Slope. A more recent example of extensive vehicle track disturbance occurred in Canada during the summer of 1970 on the Sabine Peninsula of eastern Melville Island. At that time a blow-out occurred at a wildcat well being drilled in the Drake Point area and vehicles were moved, of necessity, across tundra. Where sensitive tundra lowland underlain by soft-ice-rich shale of the Christopher Formation was traversed, substantial and dramatic trenching occurred (Figure 4).

In general, however, severe erosion associated with vehicle tracks is rare in arctic Canada and one most conclude that, for the most part, vehicle tracks present primarily aesthetic rather than terrain problems

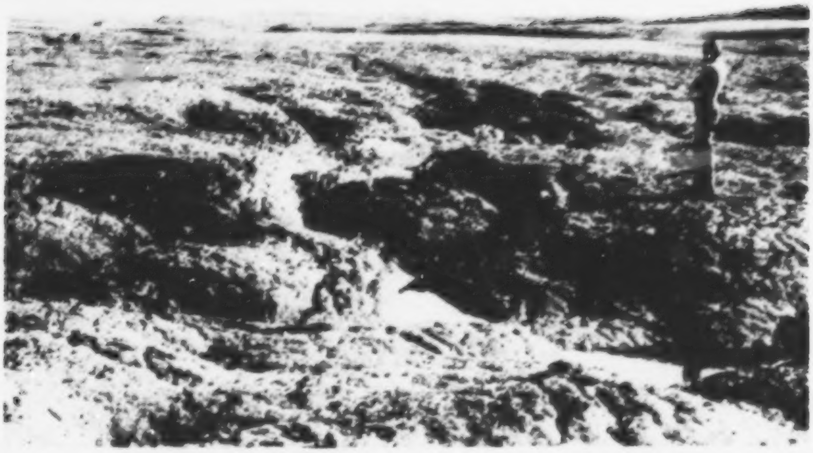

Figure 3 Terrain Disturbance: Hummocky Microrelief from Ground Subsidence

Figure 4 Trenching After Ground Disturbance

(French, 1978). The introduction of the Territorial Arctic Land Use Act and Regulations in 1971, requiring the use of vehicles equipped with special low pressure tires, and the restriction of movement of heavy equipment to the winter months has been highly successful (French, 1984). In addition, the initiation of various terrain sensitivity and biophysical mapping programs in areas of potential economic activity (Barnett *et al.*, 1977) is further minimizing this sort of damage.

Conclusion

Increasingly, man's activities are being directed towards the more remote northern regions of the world. There is no doubt that man is able to disrupt seriously these unique environments, probably with more long lasting, costly, and devastating results than in any other environment. On the other hand, there is evidence that man is capable and willing to minimize the deleterious long-term effects associated with economic development. Furthermore, the physical environment is probably better able to adjust to these impacts than is commonly assumed. Finally, improvements in industrial operating techniques in northern regions will also act to mitigate environmental impact. The challenge for the future is to ensure that the physical environment is not neglected and that its health is monitored on a regular basis.

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The Natural Realm and Arctic Heritage

E.F. Roots

Introduction

Heritage - "that which may be or is received from predecessors or passed along to successors" (Oxford Dictionary of English, 1976). The dictionary definition of heritage does not say anything about *values*, or *rights*, or *responsibilities* – yet, if I understand correctly the intent of the organizers, it is these concepts that the symposium is about. How do we value the Arctic that we have inherited; how do we ensure that the rights to that heritage are protected, and properly used by those most deserving of them; how do we, individually and collectively, recognize and exercise the responsibility to pass along a worthwhile, useable, and productive heritage to our successors?

Each of the speakers was asked to summarize major areas of "The Natural Realm" in terms of

- current knowledge
- use and conservation implications of that knowledge
- research needs.

Each of the authors has done an admirable job in summarizing the state of knowledge about the atmosphere, the maine realm, arctic landscapes, vegetation, and animal life. You will have noticed a problem in maintaining a connected theme to this description of our heritage - first we deal with the air, then the water, then the land, etc. Some of this is inevitable, for one has to start in some order, and the analytical approach is embedded in our scientific training and thinking. But our training does make it hard to use this approach to get an holistic picture of our arctic heritage. Some of our speakers have recognized this problem and tried, with some success, to relate their "part" of the realm to all the others; while other speakers have described their subject as a world in its own.

The symposium organizers envisaged the symposium approach as being a series of discussions of the *processes* operating in the main divisions of the arctic world, and thus affecting the Arctic as a whole, in all its components. Yet the reviews that have just been presented show that our knowledge of natural arctic processes is very uneven. Although we have heard many times that data on arctic characteristics and phenomena and populations are incomplete, or too few, or unrepresentative, on the whole it appears that, except perhaps in some areas of marine biology, where data are very sparse indeed, ***we know more about what is there than we understand how it works***.

In the atmospheric realm, the general role that arctic air masses play in global circulation and energy transfer is known, but data are too few, with enormous gaps where reliable measurements are lacking, to provide useful statistical information of air mass movement or to allow satisfactory modelling of high-latitude circulation patterns. The present knowledge of processes of transfer of energy and gases between ice and snow surfaces and the lower atmosphere during the widely varying yearly radiation cycle raises more problems than it seems to answer; and the effect of distinctive arctic atmospheric phenomena such as the persistent summer low-level stratus cloud in damping or sometimes triggering variations of environmental conditions on the surface is not at all understood.

In the marine area, we do have a pretty good understanding of general oceanographic processes in arctic and ice-covered waters, but very poor year-round data on water mass movements, chemical and energy gradients, stability of interfaces, patterns of nutrient supply and dispersion, biological populations, or local or regional response to climate change or addition of new substances.

In the area of land forms and physiographic processes, we have a pretty good idea how the present landscape got that way, but are much less sure about how stable it is, how rapidly it will change and by how much when conditions are disturbed. And what are the interconnections and interactions between biological, geological, geochemical and hydrological processes.

As for the marine, coastal and terrestrial ecosystems, the picture that emerges is one of in places good but generally uneven knowledge about the components, some understanding about relations and interactions between components, but really very little reliable information on rates of change, year-round events, stabilities, or effects of imposed disturbances.

I will make a few comments about the individual papers, and conclude with some personal remarks about the significance of our present state of knowledge to the issues of the responsible use, preservation, and enhancement of our arctic heritage.

Atmospheric and Climatic Processes

Dr. LeDrew has presented an excellent summary of the geophysical fact that variations in the global physical system cause variations in climate which, while not very large in overall global energy terms, cause fluctuations around the ice vs. water physical transition in land, sea and air that result in large changes in environmental terms. And he points out that the history and well-being of biological life, and of mankind in arctic areas must be characterized by swift and hard adaptations to those variations in climate - or else extinction or abandonment of the area. These adaptations can be ruthless selection between species, development of unusual reproductive cycles in successful varieties of plants, establishment of global migration routes, evolution of distinct native cultures and high adapted societies, or innovative engineering and technologies, with massive investment and import of energy-intensive practices from the south. All are a response to the arctic climates.

Dr. LeDrew does well to point out that the climate which we have come to think of as the "typical" arctic climate in the past 30 years, and even the general climate and ice conditions since the period of historic exploration, could not be considered the "normal" climate for arctic regions if viewed over a longer time scale; and that on the basis of presently available evidence there is little reason to expect that the present climate will continue, even in the comparatively short term. At the present stage of knowledge, the complexity of positive and negative feedback loops affecting energy transfer and storage from different parts of the arctic environmental system prevent reliable prediction of the likely variations in arctic climate, although some idea is emerging of the realistic range of variations that might be expected.

We have much to learn about the climate processes themselves, and their stabilities and interactions, in arctic regions. We have even more to learn about how climatic information and knowledge of changes could be used in planning strategies for human behaviour. If we knew with more certainty what the arctic climate was going to be like, would we be able to make more effective use of the sensitive and surprise-ridden arctic environment? How would knowledge of impending climate change be reflected in social and economic development policies?

The better understanding of arctic climate is a matter of exciting climatological and environmental research. The use of such understanding to improve human affairs is a matter of social and behavioural knowledge, policy development, and economics. It is also a matter of *humility* (to admit willingly that humans are not in control of the Arctic), of *awareness* (of the interaction of geophysical, biological, socioeconomic and political factors), and of *perspective* - in time and space scales. If we cannot incorporate these viewpoints into our value systems and policies, our arctic heritage will continue to be at the mercy of sensitive climatic variations despite increased scientific knowledge, and our use of that heritage will as in the past continue to be through painful and sometimes tragic trial and error.

Marine and Aquatic Processes

Drs. Baker and Angel have pointed out the relative isolation of the Arctic Ocean waters, and their relative internal stability compared with other oceans. Other important features include the prevalent ice cover that drastically cuts down the penetration of radiant energy for photosynthesis, and reduces gaseous exchange with the atmosphere. When these distinctive features of arctic waters are added to low temperature, one gets the typical features of arctic marine ecosystems:

- low net productivity;
- extreme range of productivity from margins to interior of the ocean;
- simple food chains;
- highly adapted behavioural responses to physical stresses.

Despite the physical stability of arctic marine waters and oceanographic structures, typical arctic marine ecosystems are vulnerable to wide swings of prosperity, with repeated episodes of famine or local extinction.

The ocean exhibits a lag effect in responding to imposed physical disturbances. The responses to atmospheric climate variations or changes in sediment run-off may be slow or delayed, but may continue after the disturbance has ceased; and arctic ocean chemistry and ecosystems may superimpose and integrate effects of disturbances that occurred in different times and locations. With regard to nutrient cycle and biological energy flow, the qualitative processes are quite well known, but the quantitative aspects, the chemical stability, and the resilience of biological pathways can be estimated with confidence only in marginal areas. Of particular concern is assessment of the regional importance of local influences, such as that of deep-draught icebergs in stirring up the surface stratification and bringing nutrients to the surface, of the variations in nutrients added by fluctuations in river flow, or of the minor but comparatively nutrient-rich inflow from the Pacific Ocean (which occasionally stops or reverses). We know that these are locally important, and responsible for pockets of local productivity around which local ecosystems and human settlements have been developed; but we are not at all sure of their role in arctic processes as a whole or their overall quantitative importance to arctic biosystems and productivity.

These concerns are especially important not only because of the risks of pollution from petroleum exploration and production activities within the Arctic Ocean and sub-arctic seas themselves, as noted by Baker and Angel, but because sub-arctic waters remain the almost exclusive source of livelihood and the cultural focus of some of the world's most distinctive societies. Not only is the arctic marine ecosystem subject to hazards from within the arctic area itself, from natural causes (climate change and geological processes), industrial development, from over-harvesting of some species and disturbance of others; but the Arctic Ocean basin is the ultimate depository for a large proportion of the persistent pollutants generated by the industrial world. The toxic substances and non-degradable pollutants generated in much of industrial North America, western Europe, or the USSR are delivered by rivers or the atmosphere to the Atlantic Ocean and thence to the arctic by the Gulf Stream and North Atlantic Drift, or they are carried directly to the arctic by long-range atmospheric transport, where we see them as the twentieth century phenomenon of "arctic haze" which is then dumped onto the sea ice and into the ocean.

Thus, important characteristics of our marine arctic heritage include a unique, vigorous but vulnerable culture based on marine mammals; significant non-renewable resources of present and future commercial and strategic interest to the rest of the world; an arctic environment and ecosystem only partly understood, which determines the distinctive nature of both traditional and modern human activities and economies and whose study is revealing insights into the processes of Nature and the workings of the planet that are valuable to the world as a whole - and the heritage also includes serving as a receiving basin for much of the modern world's most troublesome garbage.

Geomorphic Processes

Professor Bird has described the general geological setting and the processes of land form development that have produced the arctic land masses and the arctic landscapes as we know them today. This is the setting on which the human drama is very largely played, as it has been in the past and will be in the future. It is this setting and these processes that provide the intrinsic value of our arctic heritage, from habitat for caribou to protected harbours, petroleum deposits and permafrost.

It was pointed out that the major features of the arctic landscape and marine geography - the geological framework and the rock materials - are the result of global geological history, of the slow migration and mosaic build-up of fragments of continents and the opening of ocean basins.

These characteristics are not distinctively arctic or polar in nature. Non-polar processes and the global geological history have determined the presence, characteristics, and distribution of the non-renewable resources found today in the arctic. But the typical arctic landscapes, the nature of the surface materials, the conditions of soil and permafrost are the result of climatically-determined "arctic" erosion, sedimentation and biogeochemical weathering processes acting on this "non-arctic" geological setting. As Professor Bird noted, although we can see the results of these processes and describe the agents at work, the mechanisms of the processes themselves, their rates and sensitivities, and interactions between one another, are not very well understood.

Thus we have today an arctic heritage in which the fundamental background - the geological setting - has little to do with the arctic and nothing to do with arctic conditions. The renewable resources component of that heritage is a result of arctic geomorphic processes acting on this background to produce range habitat, spawning grounds in streams, sea cliffs for birds, and the whole geographical setting in which natural wildlife and traditional human culture have evolved. The non-renewable resources component of the heritage is in itself almost completely independent of its arctic setting, but its development and utilization is very strongly influenced by arctic geomorphic processes and conditions - permafrost, unstable ground, ice-choked streams, sub-sea pingos, etc., etc. Many of our most difficult policy problems, as well as our technical, engineering and social development problems, are the result of the contrast or lack of compatibility between the generally positive way that arctic geomorphic processes act to provide and maintain the renewable arctic heritage, and the generally negative way that they provide an obstacle to development of our non-renewable heritage.

Lakes and Streams

Dr. Adams has made an excellent contribution not only to our knowledge but our perspective of arctic heritage by pointing out the important environmental and ecological role of lakes. Lakes are key foci for many aspects of the natural system, as well as for human activities, both traditional and modern; we take them for granted as important parts of the landscape, sources of food and habitat for wildlife, the location of summer and winter transport activities and the immediate receptacle for our wastes; yet we know little about them and careful study of their basic physical, chemical and biological dynamics throughout the full yearly cycle has been strangely neglected.

The geological and biological youth of most arctic lakes, even compared to the surrounding land, and the role of snow in prolonging the ice cover to extend the period of darkness within the lake long after the surrounding land is bathed in nearly continuous light are surely some of the most striking peculiarities of the arctic realm. But the behaviour of arctic lakes is more than a scientific curiosity. John Bayly, at the International Conference on Arctic Water Pollution Research, Yellowknife, NWT, 29 April 1985, summed up the whole complex of human social, cultural and economic reasons for being concerned about environmental pollution in the arctic by stating that the irreplaceable value of our arctic heritage was demonstrated by the widely known fact that the best cup of tea to be obtained through the whole year was made from candled black ice in early summer, and that old Indian grandmothers knew just where to go, at break-up time, to obtain the "tea ice." In all the pure fresh water of our unpolluted streams and lakes in the arctic, there is none so pure as that of the black-ice candles from lakes of a certain size and freezing history, and in few societies anywhere in the world is there a cultural discrimination so well developed as to put a truly high value on the difference between a very good cup of tea, which is obtainable from good water almost anywhere in the north, and an absolutely excellent cup of tea, obtainable only a few weeks in the year from ice which has had a special hydrocryological history. These distinctive environmental variations, and the distinctive cultures that can capitalize on and appreciate the variations, are an essential part of our arctic heritage. Such an heritage is truly irreplaceable.

But the human aspect of our arctic hydrological heritage is more than knowing where to find the best cup of tea. As Dr. Adams has highlighted, there are difficult problems of resource management in aquatic systems where fish production is very low but the standing stock of large mature fish is high; where the vagaries of snow cover and texture, either natural, or influenced by a single road or trail of a mechanical vehicle can have the effect of changing the nature of the underlying ice and thus changing both the oxygen production (and from that the biological productivity) and the subsequent mechanical erosion of shoreline and bottom of large parts of a lake; where a winter drilling operation or artificial ice platform can affect the water structure and lake chemistry for a whole year just by compacting or flooding the snow, without adding a single pollutant; where pollutants accumulated in the surrounding catchment basin during the winter and released during snowmelt in the spring can have distinctly different effects depending upon whether, because of the temperature conditions during a critical few days, the pollutant-laden waters flow over the top of the ice, under the ice along the top of the water mass, or along the lake bottom before mixing.

All these variations, which can in some cases serve to magnify in hydrological systems the effects of minor human disturbance of the environment, must be understood and appreciated before we are able to manage wisely our terrestrial and aquatic arctic heritage.

Vegetation - Floral Processes

Professor Wielgolaski has described the broad zones of arctic vegetation and pointed out they are a response to severe climatic conditions, as expressed mainly by the amount and duration of ambient heat (e.g. the hours of surface temperature above 0° C and above 5° C) in any series of years, modified by geological and physiographic factors and the occasional extremes of high or low temperature. He has given us a fascinating account of how individual plant species have adapted and modified both their form and behaviour to survive and reproduce under conditions of low energy flow and the repeated phase transition from liquid to solid water, which is destructive or inhibitory to plant growth in most parts of the world. One result of this adaptation is the relatively small number of species that prosper in the arctic, and at the same time the wide variety of arctic habitats and arctic conditions in which these successful species are found, and to which they have accommodated by selective changes in life cycle and behaviour as much as by adaptation in form and structure.

Thus, a very important and distinctive part of our arctic heritage is not only the floral assemblage as we find it, but also the highly developed capacity and flexibility of arctic vegetation to accommodate to a wide range of harsh environmental conditions and severe interruptions of energy flow. This capacity, won at great biological cost through rapid ruthless evolution (less than 10,000 years for the most part) is a very precious but often little-recognized part of our arctic heritage.

Professor Wielgolaski gives us a picture of the Arctic which, in vegetative terms, is a land of rugged individualists on the frontier of vegetative development - of every species and every plant for itself - or else a tight partnership between specialized species, as in the lichens. In a comparative sense this is true; but as with other rugged individualists on the frontier, like explorers or cowboys or entrepreneurs, the successful plants depend on a community, often inconspicuous, without which they could not succeed. Just as the cowboy of the frontier, even teamed with his horse like an alga is teamed with a fungus in a lichen, could not be a rugged individual without Mr. Stetson to make his hat and Mr. Colt to make his pistol, so the most distinctive arctic plant could not exist without the support and interaction from other trophic levels, especially the subsoil microbiological components, whose nature and welfare are critical to the entire arctic terrestrial ecosystem. We know much less about this background community, its processes and interactions, its stability, vulnerability to disturbance and rates or steps of adjustment to new conditions, than we do about the conspicuous species themselves. Among the most important gaps in our knowledge of our arctic heritage and thus of our ability to appreciate the Arctic as we know it and to use it wisely is our lack of understanding of what goes on just beneath the surface.

Animals - Faunal Processes

The paper by Cooch, Stirling, and Gunn is an authoritative review of the status of knowledge and major areas of concern about the larger mammals and birds which for most people, both northerners and those in the rest of the world, must readily typify the distinctive arctic environment. This succinct summary by leading researchers in the field leaves little to be commented upon; but some points may be drawn again to your attention because of their relevance to the broader themes of this workshop:

1. We should bear in mind the obvious dependence of birds and marine and terrestrial mammals on special environmental features and processes; the importance, for a whole region or food chain, of a few critical topographic locations, or of environmental conditions at a few critical times of the year. At the same time the nature of the environmental processes that are critical to key components of the faunal assemblage, and the factors of dependence of those components on environmental conditions are not very well understood. Because of this, we are not able to explain very well, much less predict with confidence, the effect that a given environmental change or man-made disturbance will have on animal populations or, more importantly, reproduction and recruitment.

2. If arctic wildlife and natural ecosystems are to be valued and managed wisely, it is necessary to recognize the sobering fact that the distinctive survival strategies developed by arctic animals to enable them to thrive in the harsh and changeable natural arctic conditions - long life, prolonged or deferred reproduction, carefully rationed biological energy, etc. - make them particularly vulnerable to disturbance or over-harvesting by humans. Unlike their counterparts in lower latitudes, arctic wildlife has not, as a rule, developed any behavioural avoidance or survival response to these kinds of disturbance.

3. There are both policy problems and practical problems, as well as a kind of emotional hang-up, in coming to terms with the wide regional and temporal variations in natural populations and habitats that are characteristic of arctic areas. The places with highest populations of a given species may not in fact be key areas for species survival. In fact, high local populations may have come about from fortuitous and unstable combinations of environmental conditions or nutritional distribution, and may be more vulnerable to disturbance or collapse than the inhabitants of "less favoured," less prolific but more stable areas. In many areas, the populations of arctic animals

and birds as we now find them may not be sustainable naturally, even without human interference. Some species or populations are increasing at the expense of others; some are decreasing or may become locally extinct, to be replaced rather quickly by other species.

Areas where local populations are presently high may owe their present prosperity to special conditions which cannot be expected to last, and may be supplanted by other areas not presently productive but potentially capable of becoming so. This phenomenon of erratic productivity over time and location is particularly true of fish spawning in rapidly eroding streams, of the communities of marine life associated with polynyas, of nitrogen-limited rangeland habitat, and of vector diseases and parasites which lie dormant in the permafrost. Thus any attempt to consider the status quo as a static ideal is fallacious, and attempts to maintain it or restore the "balance" of wildlife to what it was in the recent past may themselves be a human disturbance of a naturally dynamic situation.

4. Migrating species are not only affected by human disturbance in non-arctic lands and seas, but through that disturbance the animals themselves may be responsible for important changes in the arctic ecosystems and thus become agents of indirect human-caused disturbance in the arctic (examples are peregrine falcons, right whales, snow geese).

5. Concern for animals as an important component of our arctic heritage must deal with the intricate tangle of socioeconomic, cultural, political and public interest factors involved in management and policies related to conspicuous arctic animals. Such concerns bring up the problems inherent in using information such as fragmentary data on population size as a measure of species prosperity, or in management according to simplistic concepts such as maximum sustainable yield – and show the even greater problems of obtaining the requisite understanding to be able to develop sound management policies on an ecosystem basis. Clearly, it is going to be necessary to have much better local and regional understanding of such things as variations and controls of range capacity and sources of food; the rates, quantities and efficiencies of chemical and energy transfer between trophic levels; and the relative stabilities and vulnerabilities of inter-species and inter-population competition. Other questions urgently needing study include the flexibility and controls of migration patterns and mating urges, the cycles of vector disease and the role of parasites in increasing or inhibiting adaptation to changing arctic conditions. Improved knowledge in all these areas is necessary before

we can manage wisely, by means other than by trial and error, our irreplaceable arctic animal heritage.

General Comments

The review of the natural realm that has opened this symposium has, for good reason, been broken into components - air, water, land, flora, fauna. But we all know that these components are inextricably linked. If I may be permitted to borrow from an earlier statement:

> In crude form there is an obvious cause-and-effect relationship between the geophysical setting of the arctic regions, the dynamic environmental and biological characteristics, and human activities and their consequences. The geophysical setting and geological history control the physical and energetic characteristics and distribution of chemical substances, which establish the geological, geochemical, oceanographic and climatic features; and these in turn determine the biological processes and thus the characteristics of arctic ecosystems. The geology determines the nonrenewable resources; geology and climate together determine the present environment, which controls the renewable resources. Together these resources set the pattern for human activities, cultures and conflicts in the Arctic. But this basic dependence is one-way; changes in geophysical conditions or oceanographic characteristics undoubtedly affect arctic ecosystems, but changes in present-day ecosystems in themselves rarely affect geophysical or oceanographic processes...the one-way nature of this relationship is not true over geological time; our petroleum and limestone deposits are the result of ecological changes in the past (Roots, 1982, p. 217).

Evidence is now accumulating from many sources that suggests that, over time, biological processes play a more important role in determining the physical, geological and climatic character of the planet Earth than has heretofore been generally realized. And the polar regions with their distinctive biological and physical processes, play a vital and indispensable part in the evolution of all parts of the planet – and all its inhabitants.

It is this marvellous inter-linked sequence from the basic geometry and evolution of the planet to the distinctive arctic ecosystems and the human activities developed within them that constitutes our arctic heritage. Humans, traditionally at the top of the biological food chain and adapted to the geophysical and climatic energy flows, have been part of that system. As long as we remained at the top of the system in the arctic we could be its beneficiaries without disturbing its workings. It is when we have begun to interfere significantly at lower levels in the system, by injecting energy in localized amounts imported from non-arctic areas, rearranging the chemistry and the climate, disturbing physiographic processes, attempting to short-cut energy flows, and disturbing lower trophic levels in the biological chain (by, for example spilling oil or disturbing the ground) that our activities, however localized, run a serious risk of wreaking quite widespread and irreversible disturbance of our own arctic heritage.

As we consider the range of questions related to land use and conservation within our arctic heritage, let us bear in mind that we are, after all, dealing with questions of *values*, *rights*, and *responsibilities*.

And in considering how to make use of what knowledge we have of the natural realm in order to use that heritage in an optimum manner for our own socioeconomic benefit today and to pass it on, dynamically changing but enhanced in value, to the future, let us bear in mind three cardinal rules of living successfully on this planet. Let us try to develop policies and practices that show:

- *humility* - to admit willingly that humans are not in control of natural processes but are part of them; to work within the natural system, not outside of it or futilely against it;

- *awareness* - of the interaction of geophysical, biological, socioeconomic and political factors and the need for continually increased knowledge and understanding if we are to learn from our own experiences; of the variety not only of natural features and processes but of human experiences, responses and legitimate viewpoints; and

- *perspective* - in time and space, of the importance and inter-relation of sudden events and of slow evolution, of microscopic activities and global dynamics, and the place of human myths, cultures, investments, engineering and geopolitics in all of these.

Our arctic heritage is not only the sum total of arctic natural and cultural factors as perceived by humans today. It is also the heritage of habits and expectations, knowledge and problems that we bring from the rest of the world and apply to the arctic. It includes the natural and human factors characteristic of the arctic regions that have important influence on natural processes, resources and human activities in other parts of the world. These are two faces of the same coin of human heritage. It is our responsibility to try to recognize and use these two faces of the arctic coin to give a lasting and enhanced value.

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Summary of Discussion on The National Realm in the Arctic

Editors

The discussion in this opening session touched upon numerous topics. However, the central theme was the real and perceived status of northern science and system knowledge. The opinion was expressed on several occasions that real progress has been slow to evolve and understanding of geophysical, biological and climatogical processes is uneven at best. This unevenness was described as having management implications as the needed and available data vary considerable among processes, systems and species. Although appreciable progress has been made in designing and developing inventories that answer the "What" question, much less progress has been realized in the last decade in determining and plotting the fundamental interrelations, the "How", "When" and "Why" questions.

Participants debated a series of paired characteristics of the arctic environment in the context of resource development, for example: complexity versus simplicity; stability versus dynamism; sensitivity versus durability; and adaptability versus vulnerability. The opinion was advanced that an integrated systems' approach, which included the human use system, must become the accepted research management practice. The discussion of endogenous and exogenous arctic environment stresses that impinge upon migratory birds and other animals drew attention to the need for improved international research and management agreements and other institutional arrangements.

The definition of the term Arctic Heritage was said to be as complex and as varied as the actors (and agencies) who may have the opportunity to use it – native peoples, scientists, managers, educators, politicians, and mass media reporters. The opinion was advanced that the term was a good one because it embraced broad situational differences and contexts and was relevant and salient.

The discussion progressed to a consideration of nomination criteria for protected areas and reserves. The point was made that geophysical attributes of landscape and environment should be as important as the biological.

LAND USE AND CONSERVATION IN THE ARCTIC: SESSION I

Old Hudson's Bay Post, Wager Bay
Courtesy: Murray McComb

Circumpolar Protected Areas: An Overview of The North

Zbigniew Karpowicz
Jeremy Harrison

Introduction

The review mechanism is an important process in the cycle of establishment and functioning of both protected areas and protected area systems. Data gathered during the regular monitoring of individual areas and systems is used to evaluate the success of an areas' management policies, and, periodically, to identify the completeness of the coverage of systems. The end result is the identification of priorities for action.

As the title suggests, the aim of this paper is to provide an overview of the current protected area situation in the northern circumpolar region as a whole. Both the arguments made, and the analyses presented, are formulated in the belief that the principal objective in the management of circumpolar habitats must be the conservation of natural landscapes and their values (including the species of flora and fauna that comprise them), together with the control or prevention of further unnatural and negative modifications. An integral part of this conservation process is the formal establishment of protected areas, and their effective management.

This overview approach aims to supplement national papers in this volume by providing a broad summary and analysis of the present protected areas situation in the northern circumpolar region, as well as highlight gaps in the protected area systems, identify trends and suggest areas for future development. It would also have been of value here to attempt an assessment of the conservation status of these protected areas, and to examine the effectiveness of their management, but this task was somewhat beyond what could be achieved within the available time.

The information for the evaluation of this rather "artificial" and geographically widespread territory has been limited and in some cases dated. Evaluation has relied heavily on the information currently available to the IUCN Conservation Monitoring Centre (CMC), and to IUCN's Commission on National Parks and Protected Areas (CNPPA), obtained from various national and international sources. The paper was also available for review at the Arctic Heritage Symposium, and the contents were discussed with representatives of most countries. We nevertheless apologize for any errors of fact or omission, and look to those who are more familiar with the situation in each country to correct and update our information, and to help us fill in the gaps for our future efforts. In particular we note the lack of information for Canadian Territories, and on areas such as Forest Reserves, not regarded as protected areas in the strict sense but still of immense conservation value in many cases.

The need to review and provide a summary of the status of protected areas in the northern circumpolar region as a whole is perhaps overdue, the last attempt we are aware of having been made by Fuller (1974). We sincerely hope this paper will make a significant contribution to the review process in this region.

A Definition of the Region

The "Northern Circumpolar Region" is a difficult concept to define to everybody's satisfaction. It covers varying extents of different provinces depending on how one chooses to define it. It is therefore essential to begin with a definition of the area we are attempting to cover.

Fuller (1974), reviewing protected areas of the Polar and Subpolar, defined the regions as those underlain by continuous or discontinuous permafrost respectively, an area which in total stretches south of the 50° parallel in the easter Palaearctic (including parts of Magnolia and China), yet remains north of the Arctic Circle in Lapland. Rausch (1961) defined the northern circumpolar region as the area of sea and land extending from the pole southwards to the northern limits of the coniferous forest (taiga). But it would seem that this definition may be more appropriate to the term arctic than to the broader meaning implied by use of the term northern circumpolar regions. Similarly Holloway (1970), in discussing threatened vertebrates in the northern circumpolar regions, used the northern limits of the Eurasian and North American taiga and the Arctic water limits in the oceans as his boundaries. However, this definition throws up several anomalies which we would want to avoid, in particular the exclusion of Iceland, Alaska and the Aleutians, while including Greenland, Jan Mayen Island, northern Fenno-Scandinavia and Nunivak Island (off Alaska).

Within the Soviet Union, the country with the largest land area within the region, however it is defined, there are wide-ranging disagreements amongst geographers as to what constitutes the "Soviet North" (Mote, 1983). Burkanov (1970), for example, lists six differing definitions of the north, while Mikhailov (1976) identifies five major definitions of Siberia. Bluthgen (1970), reviewed the problems of delimitation of the subarctic, particularly in Europe, covering temperature regime, position of the arctic air masses, vegetation cover, and purely arbitrary boundaries such as the Arctic Circle, amongst other possibilities.

Given the range of definitions, and the lack of a universally applicable option, this review will discuss all terrestrial and marine areas north of 60° latitude, although in discussion the differences between this region and the Arctic Circle will be highlighted. This choice is made with some justification because it is geographically extensive enough for developing evaluations of protected areas systems. It includes totally or almost totally certain important geographical areas. It is an easily identifiable boundary (not open to redefinition). It also is a recognized administrative divide within one of the largest countries, Canada where, in the area north of the 60° parallel, jurisdiction is held by the Department of Indian Affairs and Northern Development, which exerts a control on all natural resource exploitation.

The areas within 60° N include most of Alaska, Canada's Yukon and Northwest Territories, much of northern Soviet Union, all of Greenland, most of Norway and Sweden and all of Finland. It also completely includes Iceland which apparently is somewhat of an anomaly in northern circumpolar research. It should be noted that we do *not* include either the Faeroes (Denmark) or the Shetland Islands (UK), nor do we discuss the small area of northern Quebec north of 60°.

Analysis

Protected areas in the region vary considerably in size. At one extreme there is the immense Greenland National Park of 70 million hectares, and two Alaskan areas of over 7 million hectares. At the other extreme are the 15 tiny Bird Sanctuaries on Svalbard accounting for barely 19000 hectares in total, and a wide variety of very small Natural Monuments elsewhere in the Nordic region. Also the protected areas vary widely in their objectives.

Categories and objectives of protected areas will be largely dealt with in a later section. But it is necessary to define here which protected areas we have included in the following analysis, and which have been excluded. In essence we hope to have included all sites fully protected by the "highest competent authority" which are established primarily for nature conservation reasons, and which are over 1000 hectares (or over 100 hectares if islands).

Within the Arctic Circle there are 63 known protected areas covered by this definition - over one million square kilometres. A surprisingly wide variability exists in coverage between nations, with the two largest countries, Canada and the USSR, for example, having fewer areas protected than the smaller Nordic countries. Between the Arctic Circle and 60° N are 105 areas, again with wide variation in coverage. As is demonstrated shortly wide variation also exists in biogeographical coverage.

Taking the whole region north of 60° then, there is a total of 175 protected areas covering about 1.4 million square kilometres. This represents 175 protected areas within our definition, that have been verified as being within the northern circumpolar region. No doubt other areas within the 60° N circle will eventually be drawn to our attention.

Given the above definition, which is in fact fairly loose, the sites which have been included in this analysis are listed by country in an Appendix. This information is summarized in Table 1. Coverage by protected areas in some of the larger countries looks impressive. But it must be remembered, that it is the percentage of the total land area covered which is the important figure, not the absolute totals.

It is fair to say that in many ways the northern lands are a neglected domain, and the establishment of protected areas has come to the region rather later than to other parts of the world. In fact the first protected areas north of 60° were established in 1909 when four national parks were gazetted in Sweden. During the following 40 or so years only 16 additional sites were designated before Finland declared 12 further protected areas in 1956. Her first four were established in 1938. Expansion was again rather unremarkable in the 1960s with only a further 9 areas recognized. The situation has improved significantly since then with 81 major sites declared during the 1970s. In particular one should note the establishment of five sites on Svalbard in 1973, and the Greenland National Park in 1974. The trend has continued into the 1980s with 61 areas added so far. By 1981, for example, 20 sites had been declared in Alaska as a result of the passage of the Alaska National Interest Lands Conservation Act. More recently the rate of addition has slowed.

The situation, then, has clearly improved since Fuller last reviewed protected areas in the region (Fuller, 1974). The trends and successes in individual countries across the region can be used to illustrate how the current situation has developed.

In Canada, for example, despite the fact that 40 per cent of the total land surface of Canada lies north of 60° and that the vast majority of this land area is crown land administered by the Federal Department of Indian Affairs and Northern Development, only one national park (and this largely south of the 60° N circle) had been created by 1922 despite the fact that the first Canadian national park was established as early as 1885, and 11 areas totalling over 3 million hectares (excluding provincial parks) had been established elsewhere in Canada before this date. After the establishment of Wood Buffalo in 1922 no further areas were gazetted north of 60° for the following 50 years, although Kluane was established as a park reserve in the 1940s. Since 1972 four more sites have been established and another is due to be soon. In total, the national park and national park reserve system, which now covers about 1.7 per cent of the territorial land, will have increased to cover about 5 per cent when the planned system is completed (Kovacs, 1986).

Table 1 Protected Areas in the Circumpolar Region

	Arctic Circle		60°N		Total	
	No.	**sq. km**	**No.**	**sq. km**	**No.**	**sq. km**
Canada	2	31,640	3	71,588	5	103,228
Finland	10	7,103	24	939	34	8,042
Greenland	2	710,500	0	0	2	710,500
Iceland	–	–	21	7,894	21	7,894
Norway	20	2,936	24	8,675	44	11,611
Norway-Svalbard	5	34,913	–	–	5	34,913
Sweden	12	12,664	11	661	23	13,325
US-Alaska	9	205,692	17	267,399	26	473,091
USSR	6	48,633	9	32,921	15	81,554
	66	1,054,081	**102**	**390,077**	**175**	**1,444,158**

Table 2 Protected areas analysis by biome

	Number	Area (sq. km)
Tundra Communities (9)	24	1,096,073
Temperate needle-leaf forests (3)	111	326,280
Lake systems (14)	1	409
Subpolar deciduous thickets (5)	37	10,704
Temperate rainforests or woodlands (2)	2	10,692

It should be noted that although development of protected areas north of 60° in Canada has been rather slow, those areas that have been established are some of the largest in the country. Five national parks/park reserves in Canada each encompass over a million hectares, Wood Buffalo, Kluane, Auyuittuq, Jasper and North Yukon. Of these Auyuittuq and North Yukon are largely north of the Arctic Circle. Kluane is completely north of 60° and Wood Buffalo about one-fifth. Only Jasper is completely outside the region.

The same argument can be extended to Greenland. No protected areas were established here until 1974, when Greenland National Park was gazetted. The only area formally established since then has been the Melville Bay Nature Reserve (in 1977). However, the national park covers 70 million hectares and the Nature Reserve over a million hectares in total or about one-third of Greenland. The Greenland National Park is larger than any other single protected area in the world by virtually an *order of magnitude*. It could be noted here as well, that although the areas were only gazetted in the last few years, conservation activity began here many years earlier.

On Svalbard, no areas were established until 1973 despite proposals having been made as early as 1914 (Norderhaug, 1986). However the five areas established then (two nature reserves and three national parks) cover about half of the island group. Further areas have been added since then, though in this case the areas are either fairly small, or protection is incomplete.

It has been noted above that there are wide differences between the national protected areas systems within the northern circumpolar region. This can perhaps be best seen in a comparison between Northern Canada and Alaska. With the passage of the Alaska National Interest Lands Conservation Act (ANILCA) in 1980, 41,684,000 hectares of land were given permanent protection; 28 per cent of the land surface of the State (Swemm and Cahn, 1984). Areas controlled by the National Park Service and the Fish and Wildlife Service now cover some 53,347,025 hectares (Milne, *in litt.*; Division of Realty, 1984), with all "conservation system units" covering some 55.4 million hectares; 36 percent of the land surface of the state (Stenmark, this volume).

In the adjoining territories of Canada the situation is quite markedly different, with only 10,322,735 hectares protected including the whole of Wood Buffalo which is largely south of 60° This represents between two and three per cent, of the area of the territories. This total may ignore some of the protected areas set up by the territories, and excludes the bird sanctuaries and National Wildlife Areas where protection is not necessarily complete. The totals in Alaska and the territories are therefore not strictly comparable; the difference is nonetheless staggering.

It has been suggested (Nelson, 1984; Inglis, 1984) that one of the major reasons for failures of protected area establishment in Northern Canada is the complex and changing nature of the jurisdiction involving conservation matters. There has perhaps been a preoccupation with the economic development aspects of the "balanced development" concept introduced in 1969. As industrial activity has increased, conservation has become a "sector specific interest in conflict with development actions" and on occasion also in conflict with traditional life styles.

In contrast to the somewhat confusing situation in Northern Canada, Swem and Cahn (1984) reported that the protected areas legislation in Alaska gave special consideration to long term subsistence, cultural and land ownership needs of the native people, as well as wildlife and ecosystem protection and migratory patterns of bird and other wildlife. Most importantly, the boundaries of the conservation units were drawn up so that 95 per cent of all Alaskan lands with proven oil or gas reserves (and all of the Outer Continental Shelf) would be open and available for development by private industry. Also 84 per cent of areas with favourable hardrock mineral potential would be outside conservation units and 91 per cent of the State would be open to hunting. For this purpose some of the national parks and reserves were established in such a way that traditional hunting could continue, whilst a special category of lands, the National Preserve, has been used to delimit areas (some 8.6 million hectares) which are to all intents and purposes national parks except that sport hunting and trapping may be allowed (Stenmark, 1986).

Nelson (1984) suggested that the Alaskan example may well be followed by its neighbour, Canada. He suggests that due to the ever-increasing environmental pressures being placed on northern areas, two major management responses are being enacted, the use of general land-use management arrangements, and the establishment of protected areas of various types. Various moves in this direction have been taken and inventories aimed at the identification of areas where future national parks could be created have been compiled by Parks Canada. This agency has (e.g. 1981) suggested eight areas for protection in the northern lands, of which one, the North Yukon National Park, has been established. A national park for Northern Ellesmere Island is currently under negotiation. A further two national parks are proposed within the Arctic Circle and three within the 60° N circle. As for more general land-use planning measures, various efforts are described elsewhere in this volume.

As in Canada, the number and size of protected areas in the USSR circumpolar regions is surprisingly small compared to the size of the country. On available information it appears that over 100 protected areas are presently designated. Most of these are *zakazniki* in which protection may not be complete and which in many cases are not managed by the highest competent authority. In 1982 it was reported that there were 145 *zapo-*

vedniki in the USSR. If this is the correct figure then 11 of these sites are located within the circumpolar north, covering 5,396,088 hectares - a rather small amount for such a large land area. There are no national parks within this region. The situation seems likely to improve, however. Syroyechkovskiy *et al* (1983) detail proposals for 22 *zapovedniki*, 3 national parks and 10 *zakazniki* north of the Arctic Circle, and a further 16 *zapovedniki*, one national park and 4 *zakazniki* north of 60°

The situation in the Nordic countries of Finland, Iceland, Norway (excluding Svalbard) and Sweden would appear to be rather better than that currently found in the Soviet Union. The percentage of land protected is not as great as in Alaska, Greenland or Svalbard, but this is hardly surprising considering the much higher population densities found in these countries. The percentage protected in "circumpolar" Norway (excluding Svalbard) and Sweden, and in Finland is around two to three per cent of the land area, comparable with Canada. However the population density in the combined Territories of Canada is approximately 60 square kilometres per person. For Norway and Finland the figure is about 0,075 square kilometres per person. and for Sweden 0.05 square kilometres although the population density falls to 0.18 square kilometres per person north of 60° Iceland's protected areas cover about 8 per cent of the land area, a figure which owes a lot to one area of 6000 square kilometres (Myvatn Laxa), protected by special Act of Parliament. This area is more than ten times as large as the largest national park (Skaftafel). It should be added in defence of the other countries of the Nordic region, that population density on Iceland is much lower, with about 0.46 square kilometres per person, a factor which is likely to make establishment of protected areas rather easier.

The Global Biogeographical Approach

National comparisons are of interest, and can be used to highlight important inconsistencies in protected area coverage, but they do not really tell us much about the conservation and protection of natural features, features which are not restricted by national boundaries. To analyse this we need to overlay the information on parks and reserves onto "biogeographical" maps rather than "political" maps.

The principle of using a biogeographical classification system to estimate the coverage of major natural systems by protected areas has been well discussed elsewhere (e.g. Polunin and Eidsvik, 1979; Harrison *et al*, 1982; Harrison, in prep.). The principle global systems are those of Udvardy (1975) for terrestrial regions, and Hayden *et al* (1984) for coastal and marine environments.

Terrestrial Environments

Udvardy's broad conceptual framework (which is currently under review) has had several revisions proposed (e.g. Krinitsky, *in litt.*) and has its recognized limitations. The Udvardy framework is nonetheless a useful and widely recognized biogeographical grouping which is primarily intended for use in the evaluation and planning of protected areas systems.

The northern circumpolar region includes the northern sections of two of the biogeographic *realms* defined by Udvardy (1975), namely the Neararctic Realm and the Palaearctic Realm. Udvardy divides the Neararctic into 24 *provinces* covering 10 (out of 14) of the world's major *biome* types, and the Palaearctic into 57 provinces covering 11 of the major biome types. Taking the areas within the 60° N circle as a whole there is complete or partial inclusion of 19 provinces (out of 81) and five biomes (out of 11) (Figure 1). It is against this backcloth of 19 provinces and five biomes that the protected area systems information is initially analysed.

Only two provinces, the Arctic Desert (2.25.9) and the Subarctic Birchwoods (2.6.5) occur entirely within the Arctic Circle, while two more, the High Arctic Tundra (2.26.9) and the Arctic Archipelago (1.15.9) are all but within the Arctic Circle.

Within the 60° parallel four additional provinces, Greenland Tundra (1.16.9), Arctic Desert and Icecap (1.17.9), Icelandian (2.5.5) and Lowland Tundra (2.27.9) are wholly covered and three more, Yukon Taiga (1.3.3), Alaskan Tundra (1.13.9) and the Lake Ladoga provinces (2.42.14) are almost completely included.

Therefore the following 11 provinces are completely or almost completely (*) within the area under consideration:

Yukon Taiga*	**(1.3.3)**
Alaskan Tundra *	**(1.13.9)**
Arctic Archipelago	**(1.15.9)**
Greenland Tundra	**(1.16.9)**
Arctic Desert and Icecap	**(1.17.9)**
Icelandian	**(2.25.9)**
Subarctic Birchwoods	**(2.6.5)**
Arctic Desert	**(2.25.9)**
Higharctic Tundra	**(2.26.9)**
Lowarctic Tundra	**(2.27.9)**
Lake Ladoga*	**(2.42.14)**

while the following have a part of their area north of 60° parallel:

Canadian Taiga	**(1.4.3)**
Canadian Tundra	**(1.14.9)**
West Eurasian Taiga	**(2.3.3)**
East Siberian Taiga	**(2.4.3)**

and the following just reach into the region:

Sitkan	(1.1.2)
Aleutian Islands	(1.12.9)
Kamchatkan	(2.7.5)
Boreonemoral	(2.10.5)

Obviously those provinces either wholly within the 60° parallel, or almost so, will be the ones concentrated on here, while those areas to the south will be dealt with rather less.

The circumpolar region includes most of the world's tundra biome (9) as defined by Udvardy, in fact all of that in the Palaearctic, and large areas of the temperate needle-leaf forests/woodlands biome(3).

According to our current information, protected areas exist in all three of the possible biomes found within the Arctic Circle, and within all five of the biomes found between 60° north and the Arctic Circle (Table 2). It has been reported elsewhere (IUCN, 1985) that no protected areas are found within the Lake Ladoga province in the Soviet Union. However the Nizhne-Svirsk *Zapovednik*, located on its south-eastern shore, contains a part of the lake (up to the 5 metre isobath).

The biological interest of each biome type varies geographically and the important division to study is actually the provinces defined by Udvardy (Table 3).

Turning our attention first to the protected areas coverage of the biogeographic provinces within the Arctic Circle, there are existing areas in 10 or the 12 possible biogeographic provinces, whilst in the 60° north circle there are protected areas within 16 of the 19 possible provinces. This initial analysis highlights protected area gaps in the Neararctic provinces of the Arctic Archipelago (1.15.9) and the Greenland Tundra (1.16.9). There are also no known protected areas in those parts of the Kamchatkan province (2.7.5) north of the 60° N circle. This gap is not particularly important here however as there is only a small part of this province is north of 60° Therefore initially it would seem important to emphasize the complete lack of protected areas in each of the other two provinces noted above.

However, it is not only the presence or absence of protected areas which is important, but also the number and the area they cover, particularly their percentage cover of the defined biogeographical province. It would be of great value to be able to obtain the geographical area of each province, and the percentage protected. However at present such figures are unavailable, and the maps in Udvardy (1975) are too small for estimates to be made. This work is however under way and will be reported on at a later date.

Amongst those provinces completely within 60° N with fewer than five protected areas, or with less than 1000 square kilometres protected (IUCN, 1980a) are the Arctic Desert and Icecap (1.17.9), High Arctic Tundra (2.26.9), Low Arctic Tundra (2.27.9), and Lake Ladoga (2.42.14).

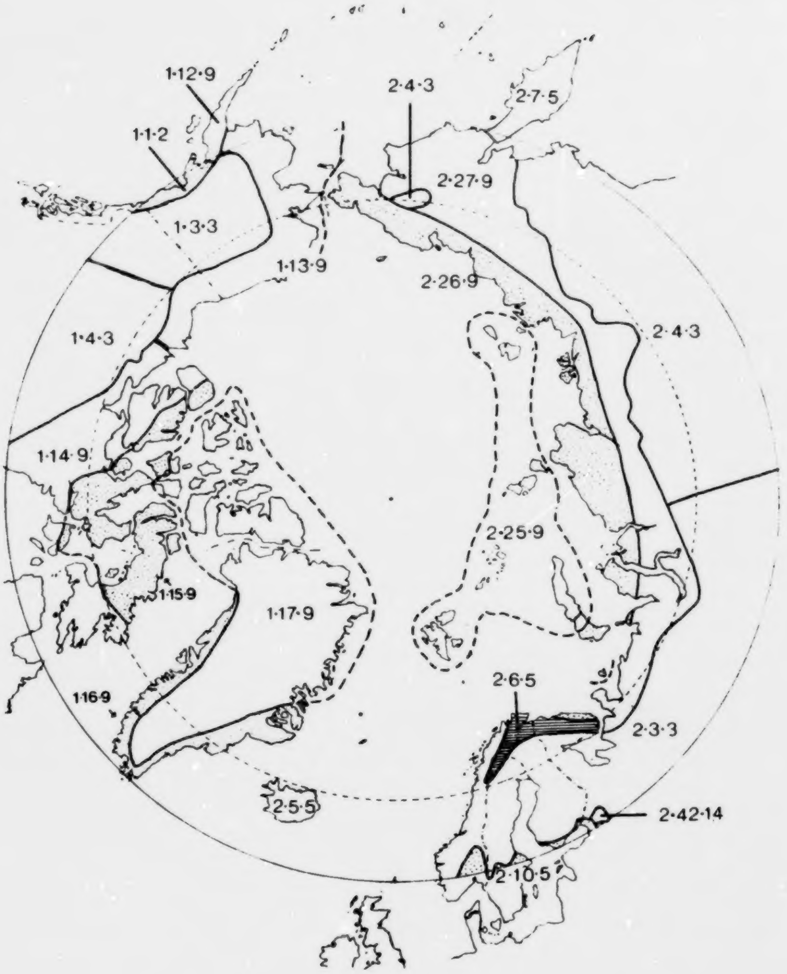

Figure 1 Biogeographical Provinces of the Northern Circumpolar Region. After Udvardy (1975).

Table 3 Protected areas analysis by province

	Number	Area (sq. km)
Yukon Taiga	12	213,438
Alaskan Tundra	8	255,541
Arctic Archipelago	0	0
Greenland Tundra	0	0
Arctic Desert and Icecap	2	710,500
Icelandian	21	7,894
Subarctic Birchwoods	12	2,559
Arctic Desert	5	34,910
Higharctic Tundra	3	32,957
Lowarctic Tundra	2	15,095
Lake Lagoda	1	409
Canadian Taiga	2	49,573
Canadian Tundra	1	21,471
West Eurasian Taiga	92	54,427
East Siberian Taiga	1	8,838
Sitkan	2	10,692
Aleutian Islands	2	25,603
Kamchatkan	0	0
Boreonemoral	4	251

Table 4 Protected areas in the Nordic region

	Number of regions	Number with Protected areas	% without
Finland	19	12	36%
Iceland	16	10	37%
Norway	24	15	37%
Sweden	14	10	28%
Total	**63**	**47**	**25%**

Of these, inclusion of Arctic Desert and Icecap is somewhat anomalous as almost half of the province is covered by the two protected areas. We could suggest, however, that further attention should be paid to the High and Low Arctic Tundra provinces, and in particular the Low Arctic which has a rather smaller area under protection.

Within those provinces which have part of their "range" north of 60° there are either fewer than five protected areas or less than 14000 square kilometres protected in the Canadian Taiga (1.4.3), the Canadian Tundra (1.14.9), and the East Siberian Taiga (2.4.13). However, a number of quite extensive areas are protected in these provinces to the south of 60° for example Polar Bear Provincial Park in Ontario, which covers 2.4 million hectares. Protected areas in those provinces which only just extend into 60° are not discussed here, most of their area is outside the study area defined in this paper.

In fact in those provinces which have protected areas, all except the Boreonemoral and Lake Ladoga have well over 18000 square kilometres protected, and most over 10000 square kilometres, but this is usually within a small number of areas–another indication of the large size of protected areas within the 60° parallel. The establishment of large areas within northern latitudes is a sound approach for a variety of reasons (e.g. Gavva *et al.*, 1986; Kovacs, 1986), but the fact that there are relatively few such areas in many cases does give the "network" an inherent instability.

Marine and Coastal Environments

Udvardy's classification of biogeographical provinces is entirely terrestrial in nature, and therefore omits a large part of the Earth's surface. To fill this gap, Hayden *et al.* (1984) have described a classification of coastal and marine environments; again a system intended for use in assessing the coverage of natural environments by protected areas. Hayden *et al.* divide marine and coastal habitats into *Ocean Realms*, *Coastal Realms*, and *Marginal Seas* and *Archipelagos*, with 40 resulting *Faunal Provinces* along the coastlines. One of the principal differences in using this system is that only faunal provinces are continuous. Whole ocean realms, coastal realms, and marginal seas and archipelagos are all disjunct in nature.

In fact in the Arctic Region (Figure 5 of Hayden *et al.*) there are no ocean realms although Ocean Realm I of the Atlantic Region just extends into our defined region to the south of Iceland and Greenland. The northern circumpolar region includes the Arctic and Subpolar Coastal Realms, Arctic and Subpolar Marginal Seas, and Subpolar Archipelagos (Figure 2). In the case of both coastal realms and marginal seas, all of the arctic areas are included within the northern circumpolar region, and a high percentage of the subpolar areas. It also includes, very marginally, an area of the Eastern Temperate Coastal Realm (the northern part of Zaliv Shelikhova, Sea of Okhotsk).

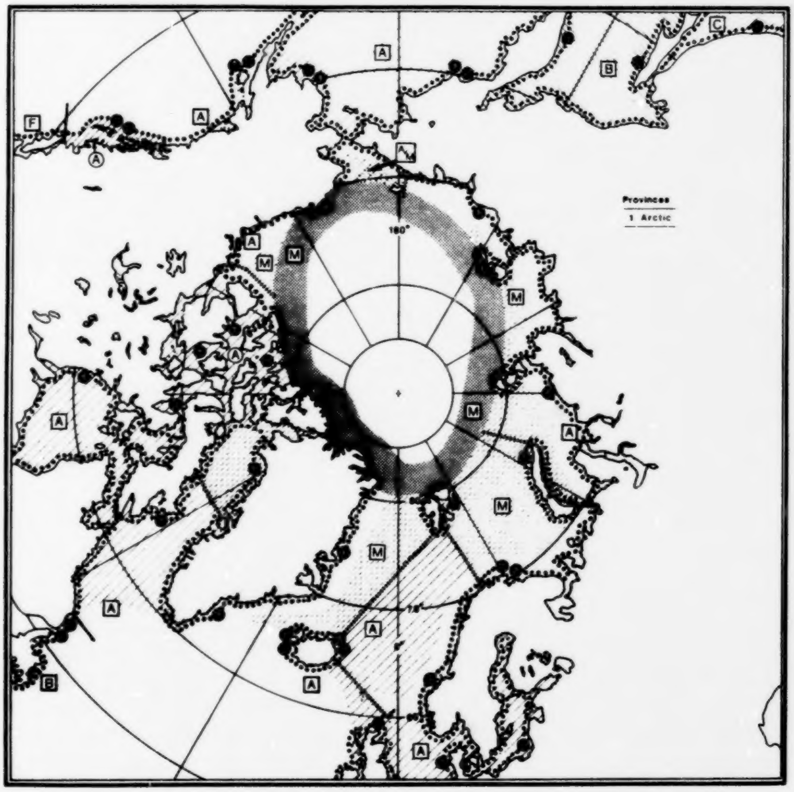

Figure 2 Coastal and marine environments. After Hayden *et al* (1984).

Shaded zones - coastal realms
Diagonally hatched zones - marginal seas and archipelagos
Dotted coastal lines - faunal provinces

M - Arctic
A - Subpolar

Most of the coastline within the region falls within the Arctic Faunal Province (Arctic Region), but also included is the East Atlantic Boreal Faunal Province (Atlantic Ocean Region) which includes the whole of the coast of Norway, Sweden and Finland from Nordkapp southwards, as well as all but the northern coast of Iceland. There are also *very* small parts of the Okhotsk and Sitkan faunal provinces.

We know that 37 of the 175 protected areas reach the coast, two in Canada, 11 in Alaska, all sites in Greenland and Svalbard, two in Finland, four in Norway, two in Sweden, three in Iceland, and four in the Soviet Union (two on the north coast, one on the Gulf of Finland, and one on the Zaliv Shelikhova). Many small islands are also protected, particularly in Svalbard, around Iceland, and along the Swedish coastline, though these are not included in the discussion here. However we do not currently know in many cases how far the jurisdiction of the protected areas extend seawards. Certainly Jussarö in Finland is mainly marine, though it is too small to be included within the current analysis, and each of the parks and reserves on Svalbard extends four nautical miles from the nearest shore (even the bird sanctuaries extend 300 metres offshore). The Melville Bay Nature Reserve on Greenland is about half sea, and the Greenland National Park also extends into the sea (though it is not clear how far out the boundary lies, and traditional hunting within the park's marine territory is permitted). Several of the protected areas in Alaska also extend offshore, but not generally very far, something which would also appear to be true of the areas within the Soviet Union.

In fact, coastal provinces and the subpolar coastal seas are *probably* adequately covered in Sweden and Alaska, and possibly so in Finland, Iceland, and Norway. Coverage off Greenland and Svalbard is fairly good. Whether protection extends *far enough* offshore is another matter. Again the areas least well covered are the coasts of Canada and the Soviet Union, the two countries with the longest coastlines.

More crucially, there are, as far as we are aware, no protected areas in the marginal seas apart from those areas just off the coasts of Greenland the Svalbard, no protected areas in the Arctic Coastal Realm apart from small areas off northern Greenland and northern Svalbard (and possibly also Alaska), and no protected areas within the bulk of the Arctic Marginal Archipelago (though Auyuittuq possibly qualifies).

In summary, marine and coastal environments would seem to be rather poorly covered by protected areas over much of the region, though we do not currently have enough information to see how poorly. This apparent poor showing may be a result of either political difficulty or omission.

It is finally worth noting here, that current proposals within the Soviet Union, if enacted, could considerably improve the situation within this country at least. According to Syroyechkovskiy *et al*. (1983), there are seven proposed areas including a four million hectare reserve in Franz

Josef Land (one million hectares land, one million hectares polynyas and two million hectares sea), the De-Long Islands, and a two million hectare reserve at Yana-Indigirka which is planned to include parts of the New Siberian Islands and the Dmitry Laptev Strait.

Regional and National Biogeographical Approaches

A global classification is essentially useful at the global level, or over large regions. The evaluation of protected area coverage within smaller areas can be carried out with rather greater precision using classification systems with a higher resolution. A variety of such systems are available for various parts of the northern circumpolar region, and it is worth noting here some of these efforts and how they are being (or could be) applied to analysis of protected area systems.

Gavva and Yazan (1984) summarized efforts to ensure adequare protected area coverage within the Soviet Union, and suggested that there were no clear-cut general principles for the establishment of a network of reserves. They went on to suggest that the reserves network be based on a system of physiogeographic zoning. The most appropriate system for the USSR would appear to be that proposed by Gvozdetskiy (1968), which divides the USSR into 18 physiogeographic countries, 88 regions and 305 provinces. Within each province, they then suggested, it would be possible to outline, by an analysis of landscape maps and satellite pictures, several representative sites from which *one* (their emphasis) could be selected. They list a number of factors which should be taken into account in this selection process, and emphasize the importance of overlaying maps of natural features. Gavva and Yazan (1984) propose a series of measure, which, if followed, would significantly improve the Soviet system of protected areas.

Borodin and Syroyechkovskiy (1983) plotted the location of *zapovedniki* within the Soviet Union onto a map of the general vegetation zones (devised by Lavrenko and Sochave) to show representational coverage. Of the 12 vegetational divisions north of the 60° parallel (eight major divisions and four sub-divisions), six have protected areas with the north and middle taiga divisions best represented, though only in the west. Six divisions have no known protected areas: the arctic tundra; pre-tundra forests; southern taiga; mountainous southern and middle taiga; mountainous tundra; and mountainous steppe.

Parks Canada, in developing a national plan for a system of national parks, has devised a map of the natural regions of Canada. The system has undergone several modifications, but in the version we have (Parks Canada, 1981) the country is divided into 48 natural regions (39 terrestrial and 9 marine) in 8 major divisions. Within the 60° N circle there are

16 regions (11 of them totally so) but only five (four of the 11) have protected areas; five (four of the 11) have proposed protected areas and six (three of the 11) have neither. Regions within 60° N with no national parks yet, and none proposed, include Northern Interior Plateau and Mountains (7), Mackenzie Delta (10), Southampton Plain (28), Ungava Tundra Plateau (25), Eastern Arctic Lowlands (37) and Western High Arctic Region(38). Of these, Mackenzie Delta, Eastern Arctic Lowlands and Western High Arctic are within the Arctic Circle, while the other three are south of the Arctic Circle, and, in fact extend below 60° More could be made of these figures, but this is beyond the remit of this paper.

Of the nine marine natural regions, two are north of 60° and neither currently has a marine protected area. Recent refinements of the map have defined 28 marine natural regions, 9 of which are found north of 60° (Taschereau, 1985), but this makes little difference to the argument. As far as we are aware, these maps have only been used in the assessment of national parks coverage, and those areas which might be considered for development as national parks.

Development of comprehensive lists of potential sites is also an important process in the selection of protected areas. Parks Canada has developed a Canada-wide inventory of Natural areas of Canadian Significance from which potential national parks will be selected, using criteria set out in the Parks Canada Policy (1979). There is also an inventory of Natural Sites being developed, from which National Landmarks will be selected. Other lists of important sites right across Canada have been made by the International Biological Programme and others, and groups such as the University of Waterloo have been assisting in the identification of important sites in parts of the northern region. The Canadian Wildlife Service is working with the Department of Indian Affairs and Northern Development to establish as conservation sites those areas regarded as being of prime importance for migratory birds (Gillespie, 1985). There are also proposals to establish a Canadian registry of Natural Heritage Areas, and as a precursor to this a national survey of databases on ecological areas is under way.

Pahlsson (1984) describes a system of physical-geographical regions that has been developed within the Nordic region (Nordic Council of Ministers, 1983). The system divides the countries into 76 physical-geographical regions (and a number of sub-regions), based on features of vegetation, climate, geology and landforms. Table 4 therefore gives a very crude indication of how well each of the physical-geographical regions is covered by protected areas north of 60° It can be noted straight away, despite the crudity of the method, that quite a few regions are, as yet, unrepresented. What the table fails to represent is the total proportion of each region protected, and where the gaps actually are. It could be noted, for example, that the majority of protected areas within Norway are in the central mountains, whilst in Iceland there is a clear northern and central-interior bias.

In fact one of the main uses of the Nordic classification now is as an aid to physical planning. Areas characteristic of the regions in which they lie, have been identified, and a database is being developed on them, which amongst other things checks the occurrence and extent of different landscape components within the Nordic countries. The information which results from such analyses can then be fed back into the land use planning process. This regional initiative builds on earlier national initiatives (Koester, 1980).

Another initiative which applies within the Nordic region (as well as the Soviet Union), is the ECE system of Representative Ecological Areas, again areas intended as reference points for all types of land use planning. It does not follow that either of these types of area are necessarily those which should be made into reserves *per se*, as the principal aim is to use them as reference areas for planning purposes. Representative ecological areas may be large enough to *include* protected areas or potential protected areas.

Many other initiatives within each country in the northern circumpolar region are aimed at improving knowledge on the environment, or aspects of it, and, as a matter of course, furnish information which can be used to assess the value or effectiveness of protected area systems. One could cite, for example, the various efforts to inventory wetlands in most of the countries.

Categories of Protected Area

In the above analysis we have included sites which are totally protected by the highest competent authority, and which have been primarily established for nature conservation reasons. However, within every country there is a range of possible classifications of protected area, classifications which reflect the need for the establishment of different areas for different objectives (and using different criteria). So far these differences have not been noted, but it is worth exploring them further in this review.

Borodin *et al.* (1984) clearly recognize the multiplicity of functions required of protected areas and the need to categorize and clearly specify objectives. They note that there are about 60 different types of nature conservation area in the Soviet Union. Under the 1968 Land Legislation Act there are four major categories of protected area, nature sanctuary (*zakaznik*), natural monument (*pamiatnik prirody*), national park (*natsional'nyi park*) and ecological reserve (*zapovednik*), however a number of other land classifications provide a degree of protection, such as State Forests and Green Belt. Apparently a very high proportion of the Soviet

Union is designated State Forest, and a significant proportion of this (reportedly 170 million hectares) is categorized as "group one" (environmental protection) forest. This includes extensive tracts of the northern forests. However such classification is not permanent, does not preclude logging, and is reportedly not always sufficiently enforced. It should also be noted that protection and control of most *zakazniki* is not at the national level but at the republic or local level, and also that many are managed as hunting areas. Nevertheless, there are nearly a hundred of these areas north of 6090, 44 of them designated for faunal conservation (Anon, 1985).

Koester (1980) has reviewed the use of definitions of protected area within the Nordic region, and the following notes concerning this region draw heavily on his work, and on that of Poore and Gryn-Ambroes (1980). It should be noted that land-use planning within the region is fairly well developed, as is the relevant legislation. The following paragraphs deal only with "legislated" protected areas.

Within Finland, three categories of protected area can be established under the Nature Conservation Act (1923); Nature Parks, National Parks and Natural Monuments, and two under the Preservation of Woodlands Act (1922); Protected Woodlands and Nature Conservation Forests. Within this review so far we have only included Nature Parks and National Parks, but it is clear that other sites will be of importance for nature conservation. For example, large areas of Lappland have been declared Protected Woodlands in order to help maintain traditional forestry practices. Also, town planning legislation includes provision for the establishment of protected areas. In total, areas protected under this legislation, and under the Preservation of Woodlands Act cover a further 39,700 square kilometres (1.1 per cent of the country).

Within Iceland, four types of protected area are established under the Conservation of Nature Act (1971), National Parks, Nature Reserves, Natural Monuments, and Recreation Areas. The first three of these categories have been included in the current review, including those reserves established primarily for "landscape" protection; however, grazing and cultivation is not necessarily excluded from the site unless protection of flora is a primary motive for declaration of the site, so Iceland may be overrepresented in the analyses. Myvatn Laxa is not protected under the Conservation of Nature Act, but by special Act of Parliament. Recreation reserves, and many of the smaller nature reserves and natural monuments have been excluded from this survey.

Within Norway (excluding Svalbard), the Conservation of Nature Act (1970) can be used to establish four types of protected area; National Parks, Protected Landscapes, Nature Reserves, and Natural Monuments. In this analysis sites within the first three categories have been considered. In addition, various State owned areas are protected to varying degrees through administrative measures, areas can be reserved for recreation purposes under the Outdoor Recreation Act (1957), and forest areas can be protected under the forestry acts; none of these areas has been included.

Within Sweden, four categories of protected area are again defined by a Conservation of Nature Act (1964, amended 1974); National Parks, Nature Reserves, Nature Conservation Areas, and National Monuments. Esping and Larsson (*in litt.*) have provided a list of national parks, nature reserves, and nature conservation areas which would be eligible for the United Nations List (e.g. IUCN, 1980b). Areas within this list north of 60° have been included within this analysis. However Esping and Larsson note that in addition there are six further national parks, 1152 more nature reserves, and 38 more nature conservation areas–as well as 500 Wildlife Sanctuaries and 1300 natural monuments. While being aware of the fact that many of these will be south of 60° and aware that many will be small, this adds a further 8000 square kilometres over the country as a whole. It may therefore be that Sweden is under-represented in our arguments as compared with Iceland (for example). Esping and Larsson also note that a further 39,800 square kilometres has been protected by government decision in northern Sweden, primarily for conservation interests.

The Conservation Act for Greenland (1974) has been used to establish both the national park, and the nature reserve, however, the general Act for Greenland on Area Planning (1977) is also intended to lead to wise use of land and natural resources. A number of smaller areas are also protected in some degree, at least from hunting/gathering activities. This is particularly worth noting as most are within the south- west coastal region.

The Svalbard Act (1925), which covers the responsibilities of Norway under the Svalbard Treaty (1920) includes conservation of nature and landscape values. National Parks, Nature Reserves and Bird Sanctuaries are established under the Act. There are also two Plant Protection Areas established by Royal Decree (1932) in central Spitzbergen which cover some 248,000 hectares. However only the vegetation is protected, and the regulations do not preclude resource exploitation.

Within northern Canada the situation is somewhat more confused because of the federal nature of the country and the particularly complex land problems in the northern region. Due to Canada's managed land use program all public land reportedly enjoys a high level of protection. Extensive areas of land have been set aside in northern Canada in anticipation of the establishment of protected areas However, despite various major organizations having prepared submissions for the establishment of protected areas right across the region, few have been established to date. Inglis (1984) reported on a review he had made of conservation programmes in NWT and Yukon. In particular he analyzed all existing and proposed conservation initiatives for the Lancaster Sound region, suggesting they were characterized by considerable overlap problems, interagency conflicts, objective uncertainty, industrial objections, site boundary disputes, lack of marine components and a focus on limited parts of the ecosystem. Kovacs (1986) explores the problems further.

Within our review we have only dealt with national parks and park reserves which have been established under the National Parks Act (1930, amended 1974). However, lands have been withdrawn (under the Territorial Lands Act) since 1970 along the East Arm of the Great Slave Lake for possible development as a national park, and a new park will be declared on Ellesmere Island soon. Further land has also been withdrawn for the as yet unestablished Old Crow portion (472,400 hectares) of the North Yukon National Park proposal since 1978. Two rivers have also been designated as part of the Canadian Heritage Rivers System; Alsek in the Yukon and Nahanni in the Northwest Territories, since 1957 under the Migratory Birds Convention Act (1917, 1970). Some of these are very large, Queen Maud Gulf covers 62000 square kilometres, Dewey Soper 8159 square kilometres, but protection is not complete in these areas, the provision of the Act do not cover land ownership, and does not exclude exploration for minerals etc.

Game sanctuaries have also been declared under territorial game ordinances, with four having been established by 1940. But these are apparently not rigidly administered. 151 northern sites were recommended for protection as ecological reserves by the International Biological Programme. However most of these areas still have no status in law, and there is no ecological reserves act in either of the northern territories (Taschereau, 1985). There are also territorial initiatives. Both Yukon and the Northwest Territories have enacted park ordinances (in 1979 and 1974 respectively), but both systems are in their infancy and the territories have, as yet, little control over their land and resources. They have substantial responsibility for wildlife, but not for habitat (Nelson, 1984).

Within the US federal legislation there are probably more defined designations of protected area than in any of the other nations with territory in the northern circumpolar region. The legislation defining all these types of areas would also take rather more space to describe than is available here. The definitions actually used within Alaska include National Wildlife Refuge, National Park, National Preserve, National Monument, National Historic Park, National Conservation Area, National Recreation Area, Wild and Scenic River, and National Forest. The first four categories have been included here (where north of 60°), thereby leaving out the Steese NCA, White Mountains NRA, and the Chugach National Forest, all between 60° N and the Arctic Circle, and together covering two to three million hectares. Also excluded are any areas that are protected by state authorities.

From the foregoing discussion we can clearly see the wide range of protected area designations and developments in the northern regions. If we add to this the zoning of individual areas, and the provision of buffer zones, and then go on to deal with multiple use zoning and integrated land use planning we can see better the complexity of the situation.

IUCN (1978; 1984), recognizing the multiplicity of protected area designations and attempting to clarify the situation, defined a series of ten management categories based on management objectives which would cover the complete range of types of protected area. In this analysis we have only looked at sites which would qualify as category I through V, or as Biosphere Reserves (IX) or World Heritage (X). The distribution of sites in each management category is demonstrated in Table 5.

The validity of this analysis by category is not entirely clear. In general the category applied to each site complies with that suggested by the management authority concerned, but experience shows that this is not entirely accurate. For example, almost all nature reserves in Iceland and Finland are category I. Does this accurately reflect the situation?

What is particularly clear is the preponderance of category II sites even north of the Arctic Circle - despite the caution of various authors (e.g. England, 1983) concerning the appropriateness of the category within delicate tundra regions. Number of category III and category V sites are much lower. Most sites that would be put in category III at present are generally too small for the analysis here, while we suspect that category V sites are currently under-represented in our figures. Note that within each category, the average size of sites north of the Arctic Circle is larger.

A brief review nationally and regionally also illustrates some differences; for example while Canada has predominantly utilized category II, the USSR has predominantly utilized category I. Only Iceland and the USA have sites listed within category III. Other differences have been noted above. In general, it would appear that either use or application of the categories is rather spasmodic, and the situation probably requires some clarification.

Table 5 Protected areas analysis by IUCN Management Category

	Arctic Circle		60°		Total	
	No.	**sq. km**	**No.**	**sq. km**	**No.**	**sq. km**
Category I	22	61,018	24	31,203	46	92,221
Category II	25	787,945	36	160,882	61	948,827
Category III	3	36,854	7	37,814	10	74,668
Category IV	12	91,028	22	153,115	38	244,143
Category V	4	77,232	16	7,063	20	84,295
Category IX	4	748,686	2	15,033	6	763,719
Category X	0		3		3	

Internationally Protected Areas

There are three international "labels" for protected areas which it is important to discuss in the context of the northern circumpolar region. These are the sites accepted by the World Heritage Committee for inscription on the List of World Heritage (here we are only discussing natural sites), sites listed by Contracting Parties to the Wetlands convention, and sites accepted as biosphere reserves under the Man and the Biosphere (MAB) Project 8. There are a number of other designations (such as Biogenetic Reserves, Representative Ecological Areas, etc), but these are not discussed here as they do not apply across the whole region. Protected areas on international borders should also be given special mention.

World Heritage Convention

The Convention concerning the protection of the world cultural and natural heritage was adopted in Paris in 1972, and came into force in December 1975. The convention provides for the designation of areas of "outstanding universal value" as world heritage sites, with the principle aim of fostering international cooperation in safeguarding these important areas. Sites, which must be nominated by the signatory nation responsible, are evaluated for their world heritage quality before being declared by the international world heritage committee. Criteria for inclusion are published by Unesco (1980; 1984).

Currently only three countries in the region have acceded to the convention - Canada, Norway, and the United States of America, and only three world heritage sites are found north of 60° these being Nahanni and Wood Buffalo National Parks in Canada and the Kluane-Wrangell-St. Elias National Park block on the border between Yukon and Alaska. Each of these areas is rather closer to the 60° parallel than to the Arctic Circle. There are therefore no world heritage sites north of the Arctic Circle at all, and the only sites north of 60° are in the western half of the Neararctic region. It would be extremely surprising if these were the only areas that could be considered to be of world heritage quality in this region, and IUCN (1982), for example, lists a further 9 sites with potential (though even this list is somewhat "unbalanced").

Wetlands Convention

The Convention on Wetlands of International Importance Especially as Waterfowl Habitat was signed in Ramsar (Iran) in 1971, and came into force in December 1975. This convention provides a framework for international cooperation for the conservation of wetland habitats. The convention places general obligations on contracting party states relating to the conservation of wetlands throughout their territory, with special obligations pertaining to those wetlands which have been designated to the "List of Wetlands of International Importance." The workings of the convention are generally described by Lyster (1985).

Canada, Finland, Iceland, Norway, Sweden and the USSR have acceded to the Wetlands Convention. The United States has recently signed the convention, and expects to ratify before long; Greenland would appear to be covered by the accession of Denmark. Of the 36 "Wetlands of International Importance" (Ramsar Sites) north of 60° that are listed by the six countries, seven are in Canada (four within the Arctic Circle), 11 in Finland (one within the Arctic Circle), one in Iceland, eight in Sweden (three within the Arctic Circle,), one in the USSR (within the Arctic Circle), and eight in Norway (six north of the Arctic Circle, five of which are bird sanctuaries on Svalbard). The area listed by Canada is very large, The Queen Maud Gulf alone covers 6.2 million hectares. But it should be noted that protection of most of these areas is incomplete. Nevertheless, the efforts made by Canada under this convention are impressive, and one can but exhort other countries, and in particular the Soviet Union, to follow their example. It is also to be hoped that the United States will ratify the convention soon.

MAB Project 8: Biosphere Reserves

The designation of biosphere reserves differs somewhat from that of either of the previous designations in that it is not made under a specific convention, but as part of an international scientific program. The objectives of a network of biosphere reserves, and the characteristics which biosphere reserves might display, are listed by Unesco (1974), and updated and reemphasized by the Action Plan for Biosphere Reserves (Unesco, 1984). These include the need for representative examples of all natural biomes, and the need for adequate long-term legal protection. All aspects of biosphere reserves are discussed in detail by Unesco-UNEP (1984).

Considering the emphasis on research within biosphere reserves, and in particular research into environmental management and the "man/nature" interaction, there is a particularly inadequate coverage of the Arctic by biosphere reserves. Canada only has two reserves, neither of them in the northern circumpolar region. This surprising situation is also reflected in the Soviet Union where out of the 14 biosphere reserves listed only two, Pechero-Ilychsky and Laplandsky are north of the 60° (two sites only added to the list in 1985). Coverage in Alaska, Greenland and Svalbard is good however, with Noatak and Denali in Alaska, and the Greenland National Park and Northeast Svalbard Nature Reserve. However, mainland Norway has no biosphere reserves, and there are none in Sweden, Finland or Iceland, despite the fact that MAB committees exist in each of these countries. We can only emphasize the need to extend the coverage of biosphere reserves in this region to cover all biogeographical provinces, and all areas which might otherwise be of value as a part of this network (see Unesco, 1974).

Border Protected Areas

Since one of the main aims of this paper is to stimulate further conservation within the regions, and a particular component of this is the furthering of international cooperation in this respect, it seems particularly appropriate to give special mention to those protected areas found along the international borders, and in particular those protected areas which meet across such borders. There are six borders on land, and two on water only those between USSR/Alaska and Canada/Greenland being considered.

There are six areas on the border between the Canada and Alaska with quite a few more on the borders between the Nordic countries. Yet none of the Soviet protected areas lie along borders north of 60° There are currently no protected areas on the (marine) borders between the USSR/Alaska and Canada/Greenland. Perhaps of more interest, there are five instances of protected areas which meet across international borders on land:

Canada/Alaska	Kluane/Wrangell-St Elias
	North Yukon/Arctic Wildlife Refuge
Norway/Sweden	Rago/Sarek-Padjelanta-Stora Sjofallet
	Fenundsmarka/Rogen
Norway/Finland	Ovre Anarjokka/Lemmerjok

with no such areas on the border between Sweden and Finland, or between either Finland or Norway and the USSR.

Conclusions and Recommendations

The circumpolar region contains very fragile systems where man-induced changes or indirect damage may be reversible only over long periods of time. Largely as a result of their isolation, many of the more northern areas have experienced little human activity. However there have been modifications.

For example, Holloway (1970) showed that the vertebrate populations of the Arctic have been affected by man's activities, though for the most part changes have occurred outside the Arctic circle. There is evidence, however, that major activities directly affecting vertebrate populations have taken place within the 60° N circle. Holloway also pointed out that although most modifications to the circumpolar environment have been attributed directly or indirectly to man, some major disruptions have been the result of climatic changes. These natural alterations have been greatest in the Greenland - Spitzbergen region (Hare, 1955). More specifically, Kelsall (1968) estimates that some 29 per cent of the area between the Great Slave and the Great Bear Lakes had been burned-over during the 20 years before 1968. There is also clear evidence that reintroduced species such as Reindeer have (at least in the past) caused excessive overgrazing in Alaska and the Nordic region (Kelsall, 1968), as well as in the northern parts of western Siberia (Mote, 1983).

Trends in use and exploitation including hunting and fishing, mining, HEP development, water diversions, thermonuclear projects, oil and gas, transportation, tourism and wilderness travel, and scientific research, were all discussed by Fuller (1974). All these forms of use still exist right across the region, though in some cases (e.g. hunting and fishing) control is perhaps tighter. Numbers of visitors (tourists of all types, and scientists) are clearly on the increase. However the most obvious environmental threats, both long and short term, still arise from the large-scale developments associated with hydroelectric schemes, and with mineral and oil and gas exploration and exploitation. The variety and magnitude of the problems posed by these activities is bewildering and exponential.

Sedimentary rock formations, potential sites for the discovery of petroleum, stretch over much of the Soviet Arctic, the western third of the Neararctic mainland and also the north west of the Canadian archipelago. These are therefore prime areas for development, and since the 1968 oil discovery at Prudhoe Bay, exploitation has been extensive across the whole of northern Canada. Oil exploitation now lies alongside the more established mineral extraction industries (which are themselves expanding). Activity is not confined to these major areas. For example exploratory oil wells are now being drilled on Spitzbergen, and mineral extraction has occurred on Svalbard for many years, and is also found in most parts of the region within the ancient granite shields, and the mountainous areas. As an example of the problem, exploitation in northern Canada is summarized by Nelson (1984).

Invariably linked to the fast expanding mineral, oil and gas operations of the northern lands is the problem of pollution (though this also includes such sources as radio-active fall out and organochlorides). Any increase in the volume of activities associated with industrial, exploitive, recreational and scientific activities entails increased risk factors for the occurrence of pollution of one sort or another in protected areas and elsewhere. Another closely associated problem is that of transport, both of people and equipment, and of their output.

Forward planning in the oil and mineral extraction industries, with environmental impact assessment of all aspects (including transport of the derived resources), is essential, and contingency programs for the reactions to oil spills and the like are urgently required across most of the region.

Weeden (1969) suggested that a progressive policy between the oil industry and government resource administration would go a long way to avoiding potential conflicts. He suggested the delimitation of key areas where economic activities (both active and passive) were totally prohibited and the instigation of strictly controlled operational standards. He stressed that the vastness and unrestricted opportunities of these northern lands should not deceive the legislators and resource operators, and that surveys and reservation of representative samples of biotopes and key wildlife areas must receive high priority. Weeden was primarily concerned with Alaska, where most of his suggestions have indeed been taken on board (Swem and Cahn, 1984), and primarily with the oil industry. However many other development projects may cause concern apart from those connected with oil, gas and minerals, in particular those relating to HEP (particularly in Canada, Norway and Sweden). In the Soviet Union the projects under discussion concerning diversion of certain north flowing rivers. Many of Weeden's arguments would apply equally to these developments.

The marine resources in the circumpolar regions are extremely important and have increased in importance in recent decades. The World Conservation Strategy (IUCN, 1980a), for example, illustrated the importance of fishery industries to certain arctic countries; 15 per cent of the protein supply of Norway is derived from Arctic waters, and 10 per cent for each of USSR, Greenland and Sweden. This can amount to 10 per cent of all export earnings for nations such as Greenland and Norway. Conservation of stocks and spawning grounds is therefore of crucial importance to these countries. While fisheries industries have continued, other marine industries have declined, most notably whaling and sealing. New threats to the oceans come in the form of mineral deposit exploration and utilization. This form of exploitation must not be allowed to develop without similar assessments and controls to those already proposed on land.

Conservation and Protected Areas

Clearly large areas north of 60° require some degree of protection, and it is probably fair to say that most of the area north of the Arctic Circle also requires protection. But the form that protection should take is another matter. There are just as clearly many legitimate claims on the land, for resource exploitation of various kinds, and perhaps more importantly in some ways as the "homelands" of a range of peoples whose life styles have become adapted in a variety of ways to the environmental extremes found in this part of the world. There are substantial populations resident within the Arctic region, and many indigenous people largely dependent on a hunting economy.

It should be emphasized therefore that any system of protected areas must be part of integrated planning within the region as a whole, and not a totally isolated system of land-use control. One of the corollaries of this statement is that use must be made of a wide range of protected area options, from strict nature reserve (where disturbance is at an absolute minimum or non-existent), through the traditional national park and nature reserve concepts, to protected landscapes and multiple-use areas. Application of these "categories" must be based on the management objectives for each area, management objectives derived from an understanding of the scientific, economic and sociological needs of each area, as well as the conservation requirements.

In general legislation already allows for designation of a wide range of "types" of protected area, although these have not always been utilized. Also several of the countries already have and employ good general planning legislation. We can only applaud and encourage these efforts, and look forward to greater integration in the future.

However, since protected areas objectives and policies vary markedly between individual countries, there is a clear need for international cooperation and co-ordination (as is already occurring to some degree in the Nordic countries). This is something specifically called for by Young (1982). Perhaps the role of international organizations such as IUCN and Unesco (in particular the MAB Program) and other expert advisors should be made clearer in this respect.

One of the key areas for international cooperation is in research. Research is vital in the planning, development and management of protected areas and circumpolar ecosystems. A major priority is the completion of biological inventories for all circumpolar regions, and the preparation of maps of natural features - particularly for those areas as yet untouched by man. It is only by these means that we can fully assess the coverage of all natural features by protected areas, and provide full information back-up for land-use programs.

As a response to the problems of conservation in the north, and a reaction to the Canadian Government's rush to develop oil and mineral resources, a number of countries joined together in 1982 to form a non-governmental organization under the title of the Northern Science Network (Simmons, 1984). The states concerned were Canada, Finland, Greenland, Norway, Sweden, and the USA, and their aim was the advancement of circumpolar studies and related developments. Three themes were highlighted; one of which was the monitoring of and research into biosphere reserves and other protected areas. Initiatives of this sort are of particular importance, and should be encouraged, though it is perhaps unfortunate that an already existing forum such as the MAB program - could not have been used for this purpose.

Another key area for international cooperation is in tourism. In certain countries it already contributes significantly to the economies (such as in the Yukon and Northwest Territories). Tourism has a valid place within the protected areas system of the circumpolar north. However, because of the fragile nature of the ecosystems, this development must be carefully regulated and supervised. In some cases areas of tourist interest will coincide with areas of scientific activity or of delicate ecological equilibria, such as occurs in the Denali National Park, Alaska. In these cases the relevant authorities need to be particularly careful in their administration of the areas, and in their "handling" of the visitors.

Within the region, the proportion of land afforded legal protection varies considerably (though in this study it has not been possible to analyse fully the conservation of all types of "biogeographic" region is clearly patchy at a regional level, let alone at the national level, and coverage in marine and coastal areas is particularly poor. The network of areas required for adequate protection of the northern circumpolar region is therefore far from complete. This could perhaps be achieved by strengthening protection in other sites not fully covered in this analysis, but these may not necessarily be the most appropriate areas.

In addition to formal legal protection being granted for protected areas, each site needs to have a site specific management plan which not only clearly identifies the objectives of the site, but also identifies how these objectives can be achieved. In most cases these clearly involve input of research results in identifying, for example, how to ensure preservation of the ecological equilibria, or how to avoid or deal with various problems and conflicts. A review of management planning within the region is only one part of a wider need to assess/evaluate the effectiveness of management of the declared protected areas. Such an evaluation, which needs to be carried out at local, national and international levels, is beyond the scope of a short paper such as this. Methods of evaluating the effectiveness of protected area management are dealt within detail by MacKinnon *et al.* (in press).

Recommendations

The following are suggested as key points for improvement of the current protected areas systems in the northern circumpolar region. The list is not intended to be exhaustive, and in making these comments we realize that most nations are already implementing (or attempting to implement) some of the measures. Items are not ranked in any particular order, and several interrelate.

1. Make detailed assessments of the effectiveness of the management of the current protected areas network, and of its capability of achieving its defined objectives.

2. Either utilize available methodologies or develop new ones to evaluate the coverage of natural features by protected areas networks.

3. Implement the results of both these evaluations by improvements in management, redefinition of existing areas, and the declaration of new areas to fill in gaps identified in the current systems of protected areas paying particular attention to those provinces identified in this paper as being deficient in protected areas.

4. In particular note the poor protection currently afforded to marine and coastal areas, and implement measures to improve this situation. In this regard particular note should be made of the guidelines proposed by Salm and Clark (1984) for protecting habitats in polar seas.

5. Develop site specific management plans for all areas, based on the defined objectives of each area, and the methods to be used in achieving these objectives.

6. Where necessary review legal frameworks/mechanisms as they apply to protected areas, and the relationship between protected areas and the surrounding lands.

7. Make full and appropriate use of the complete range of categories of protected area as defined by management objectives, and review the application of these categories within each country.

8. Continue monitoring each protected area, to facilitate continued assessment of the effectiveness of areas in achieving their specific conservation objectives, and to monitor the effects of visitor (tourist *and* scientist) impact and other impacts.

9. Complete biological inventories of northern regions and prepare maps of natural features, so as to further identify areas in need of protection and as an input to land-use planning procedures.

10. Ensure adequate and well coordinated research within the region, and free exchange of results and experiences between researchers from different nations, and between different branches of science, developers, planners, industrialists, etc.

11. Provide information on protected areas and other aspects of conservation to international agencies such as IUCN to facilitate international review and cooperation, and encourage wide dissemination of such material.

12. Designate/nominate appropriate areas as world heritage sites or wetlands of international importance (Ramsar sites), and manage them accordingly. Also note that the wetlands convention places an obligation on the state to manage *all* wetlands rationally.

13. Develop appropriate sites as biosphere reserves under the MAB program, and work to implement the Action Plan for Biosphere Reserves.

14. Develop further international cooperation in protection, conservation, research and planning within northern regions.

It should also be re-emphasized that protected areas should be one component of fully integrated land use planning programmes within the region, which take full account of all conflicting land-use requirements. Monitoring within protected areas and other areas should provide an input to the continual process of assessment of mans impact within this sensitive region, information which can then be used in the planning process.

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List of Protected Areas Included in the Current Study

Within each country sites listed in the first are those within the Arctic Circle, and those within the second group are between 60°N and the Arctic Circle.

CANADA

Auyuittuq NP	II	1.14.09	2,147,110	1972
Northern Yukon NP	II	1.13.09	1,016,865	1984
Kluane NP	II	1.03.03	2,201,500	1972
Nahanni NP	II	1.04.03	476,560	1972
Wood Buffalo NP	II	1.04.03	4,480,700	1922
Kluane-Wrangell/St Elias NP	X	1.03.03		1979
Nahanni NP	X	1.04.03		1978
Wood Buffalo NP	X	1.04.03		1983

FINLAND

Kevo	I	2.06.05	70,300	1956
Malla	I	2.03.03	3,000	1938
Maltio	I	2.03.03	14,700	1956
Sompio	I	2.03.03	17.600	1956
Vaerrioe	I	2.03.03	11,000	1982
Lemmenjoki NP	II	2.03.03	280,000	1956
Pallas-Ounastunturi NP	II	2.03.03	50,000	1938
Pyhaetunturi NP	II	2.03.03	4,100	1938
Riisitunturi NP	II	2.03.03	7,600	1982
Urho Kekkonen NP	II	2.03.03	252,000	1983
Koivusuo	I	2.03.03	2,100	1982
Olvassuo	I	2.03.03	6,000	1982
Paljakka	I	2.03.03	2,660	1956
Pelso	I	2.03.03	1,800	1982
Pisavaara	I	2.03.03	5,000	1938
Runkaus	I	2.03.03	7,150	1956
Salamanpera	I	2.03.03	1,270	1956
Sukerijaervi	I	2.03.03	1,900	1982
Ulvinsalo	I	2.03.03	2,500	1956
Vaskijarvi	I	2.03.03	1,140	1956
Helvetinjaervi NP	II	2.03.03	2,100	1982
Hiidenportti NP	II	2.03.03	4,000	1982
Isojaervi NP	II	2.03.03	1,900	1982
Itainen Suomenlahti NP	II	2.10.05	800	1981
Kauhaneva-Pohjakangas NP	II	2.03.03	3,150	1982
Lauhanvuori NP	II	2.03.03	2,650	1982
Linnansaari NP	II	2.03.03	3,820	1956
Oulanka NP	II	2.03.03	20,170	1956
Patvinsuo NP	II	2.03.03	8,800	1982
Pyhae-Haekki NP	II	2.03.03	1,350	1956
Salamajaervi NP	II	2.03.03	5,530	1982
Seitseminen NP	II	2.03.03	3,060	1982
Skargaardshavet NP	II	2.10.05	3,000	1983
Tiilikkajaervi NP	II	2.03.03	2,050	1982

GREENLAND (all sites north of the Arctic Circle)				
Melville Bay NR	I	1.17.09	1,050,000	1977
Greenland NP	II	1.17.09	70,000,000	1974
Northeast Greenland NP	IX	1.17.09	70,000,000	1977
ICELAND (all sites between 60° N and the Arctic Circle)				
Jokulsargljufur	II	2.05.05	15,100	1973
Skaftafell	II	2.05.05	50,000	1968
Thingvellir	II	2.05.05	4,200	1930
Alftaversgigar NM	III	2.05.05	3,650	1975
Askja NM	III	2.05.05	5,000	1978
Lakagigar NM	III	2.05.05	16,000	1971
Budahraun NR	IV	2.05.05	1,450	1977
Fjallabak NR	IV	2.05.05	47,000	1979
Flatey NR	IV	2.05.05	100	1975
Kringilsarrani NR	IV	2.05.05	8,000	1975
Miklavatn NR	IV	2.05.05	1,550	1977
Surtsey Island NR	IV	2.05.05	270	1965
Thjosarver NR	IV	2.05.05	37,500	1981
Vestmannsvatn NR	IV	2.05.05	1,600	1977
Esjufjoll NR (Landscape)	V	2.05.05	27,000	1978
Herdubreidarfridland NR (Landscape)	V	2.05.05	17,000	1974
Hornstrandir NR (Landscape)	V	2.05.05	58,000	1975
Hvannalindir NR (Landscape)	V	2.05.05	4,000	1973
Lonsoraefi NR (Landscape)	V	2.05.05	32,000	1977
Myvatn-Laxa	V	2.05.05	440,000	1974
Vatnsfjorour NR (Landscape)	V	2.05.05	20,000	1975
NORWAY				
Blodskyttodden/Barvikmyran NR	I	2.06.05	2,650	1983
Faerdesmyra NR	I	2.06.05	1,210	1972
Hukkelvatna NR	I	2.03.03	1,050	1983
Javreoaivit NR	I	2.03.03	3,000	1981
Karlsoeyaer NR	I	2.03.03	1,000	1977
Makkaurhalvoeya NR	I	2.06.05	11,350	1983
Nord-Fugloy NR	I	2.03.03	2,130	1975
Semska-Stoedi NR	I	2.03.03	1,300	1976
Skogvoll NR	I	2.03.03	5,500	1983
Stabbursneset NR	I	2.06.05	1,620	1983
Anderdalen NP	II	2.03.03	6,800	1970
Ovre Anarjakka NP	II	2.06.05	139,000	1975
Ovre Dividal NP	II	2.03.03	74,100	1971
Ovre Pasvik NP	II	2.06.05	6,300	1970
Rago NP	II	2.03.03	16,700	1971
Stabbursdalen NP	II	2.06.05	9,600	1970
Karlsoyvaer NR	IV	2.03.03	800	1977
Gardsjoen LPA	V	2.06.05	2,000	1983
Skipsfjorddalen LPA	V	2.03.03	5,200	1978
Strandaa/Os LPA	V	2.03.03	2,300	1983

Froan NR	I	2.03.03	40,000	1979
Grandefjaera NR	I	2.03.03	2,100	1983
Havmyran NR	I	2.03.03	4,000	1982
Nekmyrene NR	I	2.03.03	1,880	1981
Osdalen	I	2.03.03	4,800	1969
Smoldalen	I	2.03.03	1,325	1974
Vikna NR	I	2.03.03	2,100	1973
Borgefjell NP	II	2.03.03	108,700	1963
Dovrefjell NP	II	2.03.03	26,500	1974
Femundsmarka NP	II	2.03.03	38,600	1971
Gressamoen NP	II	2.03.03	18,000	1970
Gutulia NP	II	2.03.03	1,900	1968
Hardangervidda NP	II	2.03.03	342,800	1981
Jotunheimen NP	II	2.03.03	114,000	1980
Rondane NP	II	2.03.03	57,200	1962
Grytdalen	IV	2.03.03	1,600	1978
Kraakvaagsvaet	IV	2.03.03	1,190	1983
Brannsletta LPA	V	2.06.05	1,880	1983
Drivdalen LPA	V	2.03.03	1,500	1974
Hjerkinn LPA	V	2.03.03	2,000	1974
Innerdalen LPA	V	2.03.03	7,300	1977
Kongsvoll LPA	V	2.03.03	2,200	1974
Skaupsjoen/Hardangerjoekulen LPA	V	2.03.03	55,900	1981
Utladalen LPA	V	2.03.03	30,000	1980

NORWAY - Svalbard and Jan Mayen (all sites north of the Arctic Circle)

Northeast Svalbard NR	I	2.25.09	1,903,000	1973
Southeast Svalbard NR	I	2.25.09	638,000	1973
Northwest Spitzbergen NP	II	2.25.09	356,000	1973
Prins Karl's Forland NP	II	2.25.09	64,000	1973
South Spitzberen NP	II	2.25.09	530,000	1973
Northeast Svalbard Nature Reserve	IX	2.25.09	1,555,000	1976

SWEDEN

Abisko NP	II	2.06.05	7,500	1909
Muddus	II	2.03.03	49,200	1942
Padjelanta NP	II	2.03.03	201,000	1962
Peljekaise NP	II	2.03.03	14,600	1909
Sarek NP	II	2.03.03	194,000	1909
Vadvetjakka NP	II	2.06.05	2,450	1920
Alajaure	IV	2.03.03	16,400	1980
Dundret NR	IV	2.03.03	5,500	1970
Kallovaratjeh	IV	2.03.03	2,175	1970
Serri NR	IV	2.03.03	3,600	1970
Sjaunja BS	IV	2.03.03	290,000	1937
Vindelfjallen	IV	2.03.03	480,000	1974

Skuleskogen NP	II	2.03.03	2,460	1984
Sonfjallets NP	II	2.03.03	2,700	1909
Tofsingdalen	II	2.03.03	1,365	1930

Florarna	IV	2.10.05	3,900	1976
Haparanda Sandskar NR	IV	2.03.03	180	1961
Holmoarna	IV	2.03.03	2,800	1980
Rodkullen-Sor-Aspen	IV	2.03.03	579	1970
Rogen	IV	2.03.03	41,166	1976
Tandovala	IV	2.03.03	3,420	1982
Innerviskfjardarna	V	2.03.03	1,530	1974
Nordingra	V	2.03.03	6,000	1983
UNION OF SOVIET SOCIALIST REPUBLICS				
Kandalakshsky NR	I	2.03.03	58,100	1932
Laplandsky NR	I	2.27.09	161,254	1930
Taimyrsky NR	I	2.27.09	2,800,000	1979
Wrangel Island NR	I	2.26.09	795,650	1976
Laplandsky zapovednik	IV	2.27.09	278,400	1985
Kivach NR	I	2.03.03	10,460	1931
Malaya Sosva NR	I	2.03.03	92,921	1976
Nizhne-Svirsky NR	I	2.03.03	40,972	1980
Pechero-Ilychsky zapovednik	I	2.03.03	721,322	1930
Pinezhsky NR	I	2.03.03	41,244	1975
Pechero-Ilychsky zapovednik	IV	2.03.03	721,300	1985
UNITED STATES - Alaska				
Kobuk Valley NP	II	1.03.03	708,502	1978
Noatak National Preserve	II	1.13.09	2,655,870	1978
Cape Krusenstern NM	III	1.13.09	267,206	1978
Gates of the Arctic	III	1.13.09	3,322,935	1978
Alaska Maritime NWR	IV	1.12.09	1,422,500	1980
Selawik NWR	IV	1.13.09	870,750	1980
Yukon Flats NWR	IV	1.03.03	3,492,561	1980
Arctic NWR	V	1.13.09	7,306,596	1960
Noatak National Arctic Range	IX	1.13.09	3,035,200	1976
Bering Land Bridge N Preserve	II	1.12.09	1,121,457	1978
Denali (Mount McKinley) NP	II	1.03.03	2,441,295	1917
Kenai Fjords NP	II	1.01.02	271,255	1978
Lake Clark NP	II	1.03.03	1,637,351	1978
Wrangell-St Elias NP and Preserve	II	1.03.03	5,344,129	1978
Yukon Charley	III	1.03.03	696,356	1978
Innoko NWR	IV	1.03.03	1,558,704	1980
Kanuti NWR	IV	1.03.03	578,721	1980
Kenai NWR	IV	1.01.02	797,259	1941
Koyukuk NWR	IV	1.03.03	1,436,685	1980
Nowitna NWR	IV	1.03.03	631,332	1980
Tetlin NWR	IV	1.03.03	283,500	1980
Togiak NWR	IV	1.13.09	1,661,294	1980
Yukon Delta NWR	IV	1.13.09	7,942,018	1980
Denali National Park and BR	IX	1.03.03	782,000	1976
Kluane-Wrangell/St Elias NP	X	1.03.03		1979

Protected Areas and Environmental Conservation in Antarctica and the Southern Ocean

P.H.C. Lucas
P.R. Dingwall

Introduction

Antarctica is a frontier wilderness lying well beyond the reach of permanent human settlement. Man's interests in Antarctic regions in the past have been largely those of geographical and scientific exploration. Isolation, inaccessibility and inhospitable climate have combined to prevent any significant human intrusion. Today, however, these great forces for conservation are being inexorably eroded by growing commercial and scientific activity, supported by increasingly sophisticated technology. We are on the threshold of a new era in Antarctica's history, characterized by unprecedented interest in the development and use of its natural resources. The major challenge facing the world community is to establish a conservation regime for the region which will ensure that any large-scale utilization of resources can be accomplished without unacceptable damaging impacts on a natural environment of vital significance for global ecological stability.

International experience demonstrates admirably that protected areas can contribute vitally to the conservation of natural environments and living resources because: they maintain essential ecological processes and the productive capacity of ecosystems; they preserve the diversity of species, their genetic variability and the habitats on which they depend; and they provide opportunities for research, education, recreation and tourism, thereby serving social, economic, cultural and spiritual needs of societies (McNeely and Miller, 1984).

The Antarctic continent, together with its surrounding oceans, is a Special Conservation Area under international political agreement, and it has within it designated areas wherein strict protective measures apply. As such, it is often considered to be the world's largest protected area. Some argue, however, that existing protection is inadequate in the face of mounting pressure for resource exploitation (Barnes, 1982; Brewster, 1982). In this paper, we undertake a critical review of the protective measures in Antarctica and the Southern Ocean, both in principle and practice. In the light of experience elsewhere, we suggest ways in which a comprehensive and effectively managed system of protected areas could provide adequate protection while allowing ecologically sustainable use of Antarctic resources.

The geographical scope of this review includes the Antarctic continent, its offshore islands and the Southern Ocean and islands extending north to the Subtropical Convergence, which follows an irregular circumpolar line generally lying between 40-45° S latitude (Figure 1). The Antarctic Convergence, which separates Antarctic and temperate waters, is the conventional outer limit of the Southern Ocean, but our wider definition, following that of Holdgate (1967), allows consideration of those southern temperate islands which have many ecological and conservation affinities with the true subantarctic islands.

The Antarctic Environment

Antarctica evokes superlatives when describing the character of its natural environment (Holdgate, 1970; Laws, 1984; Bonner and Walton, 1985). It is the coldest, iciest, driest, windiest and highest continent on earth and is surrounded by a continuous zone of the world's stormiest seas. The continent, itself, extends over a total area of some 14 million square kilometres equivalent to about one-tenth of the global land surface. It is larger in area than Europe and about half as big again as the United States of America. A barren permanent ice cover, extending over 98 per cent of its area, incorporates about 70 per cent of all the earth's fresh water. Permanent ice shelves, 100 to 1300 metres thick, have formed around much of the coast. Some of these are vast and spawn huge icebergs. The Ross Sea ice shelf is the size of France and some years ago an iceberg the size of Luxembourg was discovered in the Weddell Sea. Each year approximately 1.4×10^{12} tons of ice break off and melt in the Southern Ocean. The continent more than doubles in size in winter with the formation of pack ice which extends more than 1100 kilometres from the coast.

Precipitation inland is sparse and on the coast the snowfall is only about 500 millimetres annually. The annual snowfall at the South Pole is the equivalent of less than 250 millimetres of water–or less than in most of the world's hot deserts. Winds are persistent and strong. Commonwealth Bay in the Australian antarctic Territory is the windiest known location on earth.

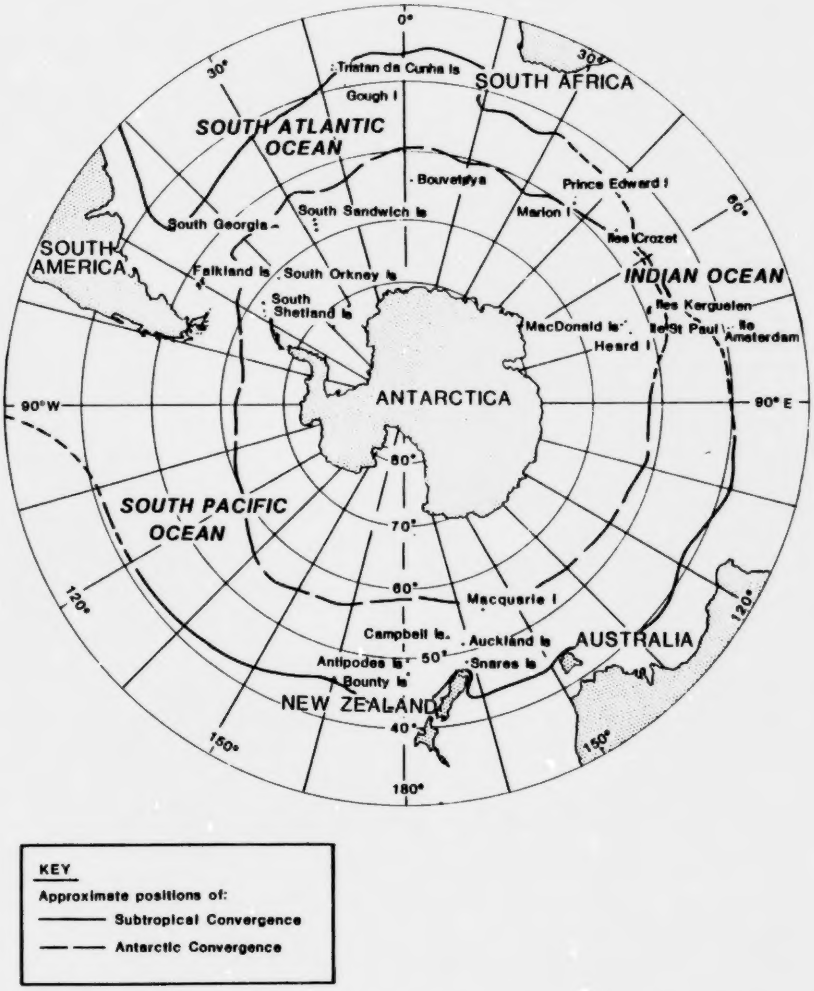

Figure 1 The southern hemisphere south of latitude 30° S, showing the Antarctic continent, locations of southern islands and the Subtropical and Antarctic Convergences.

Table 1 Antarctic Protected Areas Identified in Figure 2

Specially Protected Areas	Sites of Special Scientific Interest
1 Taylor Rookery	1 Cape Royds
2 Rookery Islands	2 Arrival Heights
3 Ardery Islands and Odbert Island	3 Barwick Valley
4 Sabrina Island	4 Cape Crozier
5 Beaufort Island	5 Fildes Peninsula
7 Cape Hallett	6 Byers Peninsula
8 Dion Islands	7 Haswell Island
9 Green Island	8 Western shore of Admiralty Bay
11 Cape Shirreff	
13 Moe Island	
14 Lynch Island	
15 Southern Powell Island and adjacent islands	
16 Coppermine Peninsula	
17 Litchfield Island	

The continental interior is virtually lifeless and the 2 per cent of land not covered in perennial snow and ice has generally impoverished plant and animal life compared to other continents. The ice-free realm occupies mountainous rock outcrops, coastal strips and islands, especially round the Antarctic Peninsula. Here there is little biological diversity due to geographic isolation, low temperatures, lack of water, persistent strong winds, and primitive soils. The flora is almost wholly crypotgamic, but there is a surprisingly complex association of lichens (200 species), mosses (85 species), microfungi (28 species) and many species of algae. Antarctica has only two species of flowering plant: the grass *Deschampsia antarctica,* and the cushion plant *Colobanthus quitensis,* much less than those present in the Arctic which has higher summer temperatures. The highest forms of native animal life on the Antarctic continent are mites and springtails.

While terrestrial ecosystems in Antarctica are relatively impoverished, those of the coastal and oceanic regions are among the most biologically productive in the world. Coastal areas are visited by millions of seabirds, primarily for breeding. Some rookeries of the abundant Adelie penguin are several square kilometres in size and the breeding season population may attain several hundred thousand individual birds. The Antarctic region is host to more than 40 species of breeding seabirds some of which,

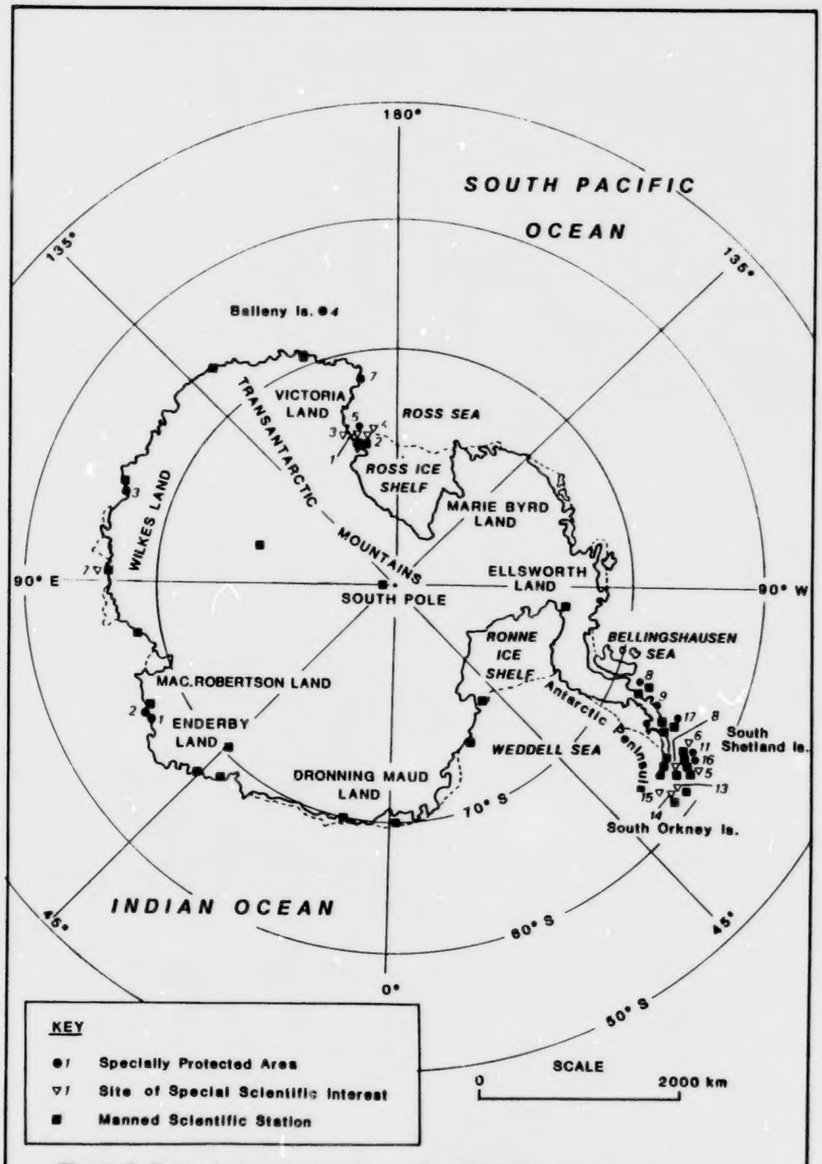

Figure 2 Protected areas and Scientific Stations in Antarctica.

such as the Adelie and Emperor penguin, are endemic. Antarctica also has six species of both seals and whales.

The southern island realm (Figure 1) can be conveniently subdivided on biogeographical grounds into three major groups as follows:

Cool Temperate Islands

This group includes Tristan da Cunha Islands, Gough Island, Ile Amsterdam, Ile Saint-Paul, Antipodes Islands, Auckland Islands, Bounty Islands, Campbell Islands, Snares Islands, and Falkland Islands (Islas Malvinas). They lie between the Antarctic and Subtropical Convergence, with trees and shrubs common and a mean annual temperature generally higher than 5^0 C.

Subantarctic Islands

A group including Iles Kerguelen, Iles Crozet, Heard Island, MacDonald Islands, Macquaries Island, Marion Island, Prince Edward Island, and South Georgia. These islands are located in the vicinity of the Antarctic Convergence. They have no trees and are dominated by tussock grasslands, herbfield and fellfield, and swamp-bog communities, with a mean annual temperature ranging between 1-5^0 C.

Maritime Antarctic Islands

A grouping which includes South Sandwich Islands, South Orkney Islands, South Shetland Islands and Bouvetoya. The vegetation here is sparse and comprises cryptogramic flora, without flowering plants. The mean annual temperature is less than 0^0 C.

Island environments are very distinctive. They reflect the overwhelming influence of their oceanic surroundings (rather more so than sub-arctic environments), and are characterized by limitations of space, restricted habitats, relatively impoverished flora and fauna, and a high degree of species endemism stemming from their geographical and ecological isolation. Perhaps the most distinctive feature underlying their intrinsic value as protected areas is the unique biota containing many endemic, relict and/or specialized species (Clark and Dingwall, 1985). For example, the Auckland Islands which have the most diverse biota of all southern islands, contain a vascular flora of 228 species (41 alien species) notable for the occurrence of three species of the megaherb ***Pleurophyllum***, a genus endemic to the region. The group also has some of the southernmost forests of the world. The 46 species of breeding birds here include eight which are endemic to the islands, and many of the several hundred species of terrestrial invertebrates are endemic. The southern islands are also critical as breeding grounds for the millions of seabirds and marine mammals which feed in the nutrient- rich surrounding oceans. Marion Island, for example, has 29 breeding birds species and a total of about two million birds. King penguins (*Aptenodytes patagonicus*) alone, number some 200,000 breeding pairs. Iles Crozet has 36 species of breeding seabirds, which is more than any other island group in the world. Five species of seals occur at the South Orkney Islands.

The biota of southern islands are also extremely vulnerable to external disturbance. The introduction of alien plants and animals almost invariably results in their rapid establishment and spread at the expense of indigenous species. Particularly devastating is the introduction of mammals, since indigenous island biota usually lacks mammalian carnivores and herbivores. The eradication of introduced mammals from islands, especially rodents, is extremely difficult and often impossible so the introduction of rats to previously rat-free islands may be ecologically catastrophic. Virtually all the southern islands have been affected by human-induced changes (Clark and Dingwall, 1985) but some remain in an essentially natural state–notably the Maritime Antarctic group of islands; Gough and Prince Edward Islands; most of the New Zealand islands; and some outlying islands in the Crozet and Kerguelen groups–and are, therefore, of extreme scientific value. They include some of the least modified oceanic islands in the world.

The island resources are among the most heavily exploited in the Antarctic region. Human contact with Antarctica commenced little more than 200 years ago, and uncontrolled exploitation of marine mammals was an early feature of human endeavour. Sealing dates from the late eighteenth century, focussing on South Georgia and the South Shetlands where tens of thousands of seals were taken before the industry collapsed in the 1820s. Elsewhere in the Antarctic, within a few seasons of their discovery, seal stocks were depleted to a tiny fraction of their original size. Exploitation of whales began in the first decade of the twentieth century, first from shore bases and by the 1920s from factory ships, thus greatly extending the impact. It is estimated that the biomass of baleen whales was reduced to about 16 per cent of its initial level, or to 35 per cent of the original numbers (Sage, 1985). Now only the USSR and Japan take whales in Antarctic waters and an end to commercial whaling is imminent as the International Whaling Commission has declared a five-year moritorium on all commercial whaling, effective from the 1985-86 Antarctic pelagic whaling season.

Commercial fishing is a more recent phase in exploitation of Antarctic marine resources. There are growing concerns over the growth and impact of the fin fishing industry, with signs of over-fishing appearing as early as the 1970's, especially around South Georgia. Fin fish, however, are a less important part of the total biomass of Antarctic waters than in Northern Seas, and attention has focussed on the abundant krill (*Euphausia superba*), with total stocks in the Southern Ocean estimated at 500 million tonnes. A large-scale krill fishery has operated since 1980, and the annual harvest–by USSR and Japan–is estimated to be 300,000 tonnes. The present harvesting level will probably be maintained over the next five to ten years, but there is a capacity for it to increase rapidly and consequent impacts, at least locally, could be severe. Krill is a vital link in the food web of the Southern Ocean and a critical resource for 5 species of whale, 3 species of seal, 20 species of fish, 3 species of squid and numerous seabird.

Of the terrestrial resources, minerals are the only ones with potential for commercial exploitation. Most minerals are known from occurrence only and any predictions on quantities are based on minimal evidence. There is strong circumstantial evidence that oil and reserves will almost certainly be offshore. While technology for recovery of hydrocarbons is not a limiting factor, any proven deposit would have to be of gigantic proportions (Saudi Arabian in size) to be economically exploitable. Oil recovery would almost inevitably result in environmental damage, the extent of which is a matter of considerable conjecture and real concern (Keys, 1984). In July 1981 the Antarctic Treaty nations adopted a resolution calling for the urgent negotiation of a regime on Antarctic mineral resources, including attention to environmental safeguards and controls. Conclusion of a minerals regime is imminent.

Antarctica's resources, then, have been exploited over a long period and the region is not pristine (Benninghoff and Bonner, 1985). However, the natural environments of the Antarctic continent and most of the Southern Islands are among the least changed of any in the world. Besides the unique and intrinsically valuable biotic communities and environments it contains, the Antarctic region is a vast outdoor laboratory for scientific studies that are of significance in understanding the whole global environment.

The special conservation values and needs of Antarctica have long received recognition from those who administer authority over the region.

Legal Framework for Protected Areas

Territorial jurisdiction in the southern realm is divided between the Antarctic Treaty Area south of latitude 60° South, with international legal and political administration, and the remaining islands north of 60° South which are administered respectively under laws and policies of six separate nations–South Africa, Australia, New Zealand, France, Norway, and the United Kingdom.

The Antarctic Treaty, which was adopted in December 1959 and entered into force in June 1961, is a remarkable international legal agreement. The thirty-one states which are party to the agreement comprise sixteen *Consultative Parties* made up of the original twelve signatories (Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, South Africa, United Kingdom, and USSR) plus four countries (Poland, Federal Republic of Germany, Brazil and India) which have more recently qualified for consultative status because they have acceded to the Treaty and have demonstrated an interest in Antarctic by conducting substantial scientific research there; and fifteen *Acceding States* (Bulgaria, China, Czechoslovakia, Denmark, Finland, German Democratic Republic, Hungary, Italy, the Netherlands, Papua-New Guinea, Peru, Romania, Spain, Sweden and Uruguay) which have no voting rights but agree to abide by the Treaty's provisions, including measures for environmental protection.

The Antarctic Treaty and its related conventions, collectively known as the Antarctic Treaty System, is a management device which regulates human activities by international consensus. The Treaty provides for the use of Antarctica for peaceful purposes only; for freedom of scientific investigation and for exchanges of scientific information. It has no expiry date and remains in force indefinitely, but contains provision for a review after 30 years of its operation (i.e. 1991), at the request of any of the Consultative Parties. These Parties also meet every two years to review scientific research, discuss matters of common interest, and to formulate measures and recommendations to further the principles and objectives of the Treaty. Monitoring of the state of conservation, and scientific advice on conservation is provided by the Scientific Committee for Antarctic Research (SCAR) which is part of the non-governmental International Council of Scientific Unions (ICSU).

Protection of the natural environment of Antarctica and the Southern Ocean is at the heart of the Antarctic Treaty System. The Treaty, itself, in Article IX, includes preservation and conservation of living resources among its principal objectives. Included within the impressive series of conventions and agreements devised under the Treaty for conservation of species and ecosystems are several instruments for establishment and management of protected areas.

The Agreed Measures for the Conservation of Antarctic Fauna and Flora (1964) consider the Antarctic Treaty Area as a Special Conservation Area, and are aimed at promoting and achieving the objectives of protection, scientific study and rational use of fauna and flora. The Agreed Measures provide specifically for the establishment of Specially Protected Areas (SPA) to preserve unique or outstanding natural ecological systems of scientific interest, which are to include: representative examples of the major Antarctic land and freshwater ecological systems; unique complexes of species; the type of locality or only known habitat of any plant or invertebrate species; specially interesting breeding colonies of birds or mammals; and areas which should be kept inviolate so that in future they may be used for purposes of comparison with localities disturbed by man. Additionally, Sites of Special Scientific Interest (SSSI) may be set apart to prevent harmful disturbance in areas where scientific investigations are being conducted or planned, or in areas of exceptional scientific interest.

The Agreed Measures also provide protection for land-based seals, while those at sea and on floating ice are protected under the Convention for the Conservation of Antarctic Seals (1972) which forbids the harvesting of three seal species, sets quotas on the catch of three others, and allows the designation of protected areas where all sealing is prohibited.

The Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), concluded in 1980, extends conservation measures beyond the Antarctic Treaty Area northwards to the Antarctic convergence. It establishes a commission responsible for, among other things, devising conservation measures to encompass: the designation of protected species; the opening and closing of regions; and the identification of regions for scientific study or conservation, including special areas for protection and scientific study. This Convention is an innovative and ambitious instrument which seeks to conserve Antarctic marine living resources, including birds, in accordance with principles of ecosystem conservation (Brown, 1983). It arose out of international concern over development of Antarctic fisheries, and requires that harvesting of target species be conducted in a way that ensures maintenance of stable population sizes, maintenance of ecological relationships between species and populations, and prevention of non-reversible changes in marine ecosystems.

Other conservation provisions within the Antarctic Treaty System of indirect relevance to protected area management are:

1. A series of *Recommendations to foresee and guard against the impacts of tourism*. These provide for a government to refuse tourist visits to one of its Antarctic stations and to regulate the activity of tourists during visits. There is also a reporting system for monitoring tourist landings elsewhere than at scientific stations, and some information is available intended specifically to inform visitors about the Antarctic environment and its conservation measures (SCAR, 1984).

2. A series of *Recommendations for the protection of historic sites*. Many historic sites, mostly huts dating from the "Heroic Age" of exploration, have been designated and, notably by New Zealand in

the Ross Sea region, huts have been restored and have wardens available to ensure security and protection.

3. A series of *Recommendations on environmental impact assessment*. SCAR has recently drawn up comprehensive procedures for environmental impact assessment, aimed at ensuring that scientific exploration and research, and related logistic support activities, avoid adverse environmental effects (Benninghoff and Bonner, 1985). These provide a rationale and general procedure which could be adapted to deal with commercially oriented developments.

Establishment and management of protected areas on those islands situated beyond the Antarctic Treaty Area are effected through national legislation. The extent and degree of security of protection vary among the island groups. For example, strict protection is provided over all New Zealand's subantarctic islands which are designated nature reserves under a national Reserves Act (1977). The South African administered Marion and Prince Edward Islands, although lacking legal territorial protection, are managed essentially as nature reserves and have statutory protection for native fauna. Only parts of the Falklands (Islas Malvinas) and Tristan da Cunha Groups are set apart under strict legal protection, but the latter is also covered by an extensive conservation ordinance which accords it the status of a multiple-use conservation area. Many of the island groups lie south of the Antarctic Convergence so protection of marine animals is provided under CCAMLR.

The Existing System of Protected Areas

Comprehensive reviews of existing protected areas are available for the Antarctic Treaty Area (Bonner and Lewis-Smith eds, 1985) and the islands of the Southern Ocean outside the Treaty Area (Clark and Dingwall, 1985). Within the Treaty Area there are 14 Specially Protected Areas and eight Sites of Special Scientific Interest, three of which are former SPAs. They cover a total area of almost 42,000 hectares (Tables 1 and 2). Three additional SPAs and one extension to an existing SPA were proposed by SCAR at its XVIII meeting in 1984. One of these is a core area contained within a proposed SSSI. Fourteen new SSSIs have been proposed by SCAR, three of which are entirely marine areas while most others would extend protection to vegetated, ice-free areas in close proximity to scientific stations.

In the Southern Ocean beyond the Treaty Area there are 20 major islands or island groups covering a total area of almost 27,000 square kilometres, or about twice the extent of the Hawaiian Islands. Of these, approximately 1500 square kilometres, or some 5.5 per cent of the total area is set apart within legally protected areas (Table 3). Several additional protected areas are known to be proposed for these islands, including four Specially Protected Areas in the Kerguelen and Crozet groups and at Ile Saint-Paul, and four Sites of Special Scientific Interest at Iles Crozet and Ile Amsterdam (Bonner and Lewis-Smith eds., 1985).

Table 2: Existing Specially Protected Areas and Sites of Special Scientific Interest within the Antarctic Treaty Area

Site	Date est.	Area (ha)	Principal feature protected
Taylor Rookery SPA	1966	Unspecified	Emperor penguin colony
Rookery Is. SPA	1966	65	Breeding colonies of 6 bird species
Ardery I. & Odbert I SPA	1966	220	Several breeding species of petrel
Sabrina I. SPA	1966	60	Representative flora & fauna of Balleny Island
Beaufort I. SPA	1966	1800	Important avifauna
Cape Hallett SPA	1966	12	Rich vegetation
Dion Is. SPA	1966	17	Emperor penguin colony
Green I. SPA	1966	20	Rich vegetation
Cape Shirreff SPA	1966	265	Diverse flora and fauna including invertebrates and seals
Moe I. SPA	1966	120	Representative flora and fauna, control reference area
Lynch I. SPA	1966	8	Extensive area of grass *Deschampsia*
S. Powell I. and adjacent islands SPA	1966	610	Representative flora and fauna of S. Orkney Island ecology
Coppermine Peninsula SPA	1970	65	Biologically diverse area, rich flora and fauna
Litchfield I. SPA	1975	36	Rich marine and terrestrial fauna, important avifauna
Total SPA area		3298	

Table 2: (continued)

Cape Royds SSSI	1975	2.4	Adelie penguin colony
Arrival Heights SSSI	1975	7	Electromagnetic 'quiet site'
Barwick Valley SSSI	1975	30000	One of the least disturbed Dry Valleys, reference site
Cape Crozier SSSI*	1975	4000	Adelie and emperor penguin colonies
Fildes Peninsula SSSI*	1975	155	Unique fossil ichnolites
Byers Peninsula SSSI*	1975	3100	Fossil fauna and flora
Haswell I. SSI	1975	80	Rich avifauna
Western shore of Admiralty Bay SSSI	1979	1200	Bird and mammal fauna
Total SSSI area		38544	
Total protected area		41842	

Table 3: Protected areas on Southern islands outside the Antarctic Treaty Area

Island Group	Legal Protection*	IUCN Category**	Protected Area (ha)	Total Island Area (ha)
Heard I	–	–	–	38 000
MacDonald I	–	–	–	260
Macquarie Is	+	I, IX	12 785	12 785
I Amsterdam	+	IV	5 500	5 500
I Saint-Paul	+	IV	700	700
Is Crozet	+	IV	22 500	50 000
Is Kerguelen	+	IV	8 000	700 000
Antipodes Is	+	I	2 100	2 100
Auckland Is	+	I	62 564	62 564
Bounty Is	+	I	135	135
Campbell Is	+	I	11 331	11 331
Snares Is	+	I	328	328
Bouvetoya	+	I	5 000	5 000
Marion Is	–	–	–	30 000
Prince Edward I	–	–	–	4 400
Tristan da Cunha Is	*	I, VIII	1 300	11 100
Gough I	*	I	6 500	6 500
Falkland Is	*	I, VIII	10 000	1 300 000
South Georgia	*	I	2 450	375 600
S Sandwich Is	*	I	–	31 000
			151 173	2 647 303

* + Specific statutes exist for land and wildlife protection
** I Scientific/Strict Nature Reserve
IV Nature Conservation Reserve
VIII Multiple Use Management Area
IX Biosphere Reserve

Discussion

At first glance, this appears to represent an impressive network of protected areas in the Antarctic and Southern Ocean realms. Indeed, a substantial basis for an effective protected area system does exist, but when it is examined in more detail several deficiencies are revealed, as discussed in the following sections.

Inadequate Ecological Representativeness

Establishing systems of protected areas which are representative of the full range of ecological diversity, both globally and nationally, has become a major guiding principle in protected area management (McNeely and Miller, 1983) and is a central tenet of the World Conservation Strategy (IUCN, 1980). In pursuing the objectives of the World Conservation Strategy, the International Union for Conservation of Nature and Natural Resources (IUCN) has accorded high priority to establishment of a widely representative system of protected areas in the Antarctic region, notably through a succession of recommendations from its General Assembly. In its formal submission to the United Nations General Assembly debate on Antarctica, IUCN stresses that sustainable exploitation of living resources without harmful disturbance to natural ecosystems carries the requirement that "...the provision of an adequate series of (reserved) areas should remain a prime objective for conservation in the Antarctic". (Timberlake and Cheney eds., 1984 p. 26). SCAR has recommended that one of the principal purposes for SPAs is protection of representative examples of the major Antarctic land and freshwater ecological systems.

To date there has not been an attempt at elaborating a biogeographical scheme to characterize the full range of terrestrial, freshwater and marine ecosystems of Antarctica as a basis for examining the ecological representativeness of SPAs and other protected areas. IUCN has developed global biogeographical schemes for terrestrial areas (Udvardy, 1975) and coastal and marine areas (Hayden *et al.*, 1984) but these require refinement when applied to a region as large as Antarctica and the Southern Ocean. A biogeographical subdivision of the Southern Ocean which recognizes distinctions among cool temperate, subantarctic and maritime Antarctic regions has been proposed as a basis for extending the ecological scope of island protection (Clark and Dingwall, 1985) and a proposed classification is available for Antarctic coastal and marine areas (Ray, 1985). But no detailed biogeographical scheme is yet available for terrestrial realms of the Antarctic continent.

In the absence of a systematic ecological basis for identification and selection of protected areas, overwhelming attention is given to unique and scientifically important features. The concept of representing a range of major Antarctic land and freshwater ecological systems in protected areas, although given prominence in Antarctic conservation measures, is comparatively neglected. Indeed, ecological diversity and representativeness are cited as primary reasons for creating only 7 SPAs and SSSIs within the Antarctic Treaty Area. The majority afford security to breeding colonies of seabirds and marine mammals, and most others protect special vegetated sites. Three areas are identified as having geological values but none is selected specifically to protect landforms, glacial features or marine environments.

Limited geographical extent and size

Protected areas within the Antarctic realm are few in number and limited in extent. Within the Antarctic Treaty Area the approximately 420 square kilometres contained in SPAs and SSSIs is equivalent to only 0.15 per cent of the continental ice-free area. Only about 5.5 per cent of the total land area of islands of the Southern Ocean is included in protected areas.

Most Antarctic protected areas are small (those on islands necessarily so), and often less than 100 hectares in size. Indeed, the guidelines for SPAs specifically state that their size should be the *minimum* required to serve their intended purposes. Moreover, little attention is given to the concept of buffer zones to minimize damaging external influences. This is of particular concern given the tendency for conspicuous aggregation of protected areas in the vicinity of scientific stations (Figure 2). Several factors have undoubtedly combined to produce this, including–the attention given to protecting sites for scientific research; the protection of best-known sites; the attraction and importance of ice-free areas coincidentally for plants, animals, and human habitation; limitations on accessibility of many areas; and the concern to protect natural biota in areas most vulnerable to damage from human interference. There are both advantages and disadvantages in this situation. While scientific attention has the potential for greatly increased knowledge, there is also a heightened potential for conflicts to arise between use and protection of sites.

Restricted scope of management objectives

The limited ecological focus of antarctic protected areas also prompts the question whether protection should serve only scientific and ecological purposes, or whether there should be an extension of protection to sites of cultural, historic, recreational and tourist value. Emphasis at present is on the strict protection of scientifically or ecologically outstanding sites where human access must be severely restricted or prohibited. This is entirely appropriate where sites, so characteristic on islands, protect habitats of endemic, relict or specialized and vulnerable species of plants and animals. However, there remains considerable scope for extending the protected area network and broadening its management strategies to allow greater flexibility in the protection and use of resources.

An invaluable guide for extending the scope of management in antarctic protected areas is available from IUCN's classification of categories of conservation management areas (CNPPA, 1984). This scheme has classes of protected areas identified according to the full spectrum of management objectives, and with varying degrees of security depending upon the relative importance of protection and use of resources.

Within the Antarctic Treaty Area protected areas almost exclusively qualify as strict nature or scientific reserves, equivalent to Category I areas in the IUCN scheme, a class which is intended for areas requiring the highest possible security for outstanding or scientifically important natural features or ecosystems. Both SPAs and SSSIs in Antarctica focus on such areas, and access to SPAs is controlled by permit. SSSIs, however, are not as secure as SPAs since they are normally protected for a specific period only; permits for entry are not necessarily required; and scientific research programs are usually being conducted within them. Essentially, they are outdoor scientific "laboratories".

Although many historic sites have been notified in Antarctica and a few are carefully managed, opportunity has not yet been taken to expand these into a series of historic and cultural reserves over larger areas which have assumed great importance in the history of human contact with Antarctica.

Nor are there reserves devoted specifically to the protection of spectacular landforms (IUCN Category III Areas–Natural Monument), or landscapes of exceptional scenic, aesthetic and inspirational value (IUCN Category IV Areas–Nature Conservation Reserve).

With active and growing commercial tourist operations in Antarctica it is timely and highly desirable that attention be given to delimiting areas that can be managed specifically for tourist visits. This is a sound strategy for reconciling existing and potential conflicts between tourist, scientific and ecological interests and objectives and for minimizing disturbance to sensitive biological communities. A promising beginning has been made to designation of areas of special tourist interest on protected islands of the Southern Ocean, such as on South Georgia.

Mounting interest in, and the apparently inevitable expansion of, resource exploitation in Antarctica make it appropriate for designation of special areas where multiple use of resources is permissible (IUCN Category VIII Areas–Multiple Use Management Area/Managed Resource Area). Such areas allow for both protection and limited, sustainable development of resources. Multiple-use management areas appear ideally suited for application in the resource-rich Southern Ocean to facilitate supervision and coordination of commercial resource use, along with essential research, monitoring and protection. Another multi-purpose strategy for protected area management which appears eminently applicable in antarctica, and which is philosophically compatible with existing Antarctic conservation measures, is the Biosphere Programme (MAB) (Batisse, 1982). In particular, this approach accommodates the dual objectives of protection and use of resources, and gives special emphasis to the role of scientific research in monitoring the impact of human use of ecosystems. Macquarie Island is the only designated Biosphere Reserve in the Antarctic region.

Inadequacy of Management Planning

Management planning has become a widely accepted and well-practised technique for translating policy into management action in protected areas. Management planning is essentially a problem-solving process, and plans are vital tools for assessing any actions in protected areas against policy objectives, and for resolving conflicts between protection and use. Ideally, a management plan should provide, against a background of essential resource information, a clear and concise exposition of the legal basis for protection, basic management goals and objectives, and the procedures or implementing policies to obtain those goals. Thus, plans might deal with the restriction on entry and use and taking of specimens, construction of facilities, and safeguards against the introduction of alien species of plants and animals. Management plans often also include specific research and interpretation of education plans.

Management plans, in this traditional sense, are singularly lacking for SPAs and SSSIs in the Antarctic Treaty Area, and are rarely available for island protected areas. Usually, they comprise simply brief statements of administrative details and the reasons for protection and, as such, they are deficient for guiding management. Without adequate management planning the potential exists for incomplete policy formulation, inconsistent application of regulations, insufficient success in handling management problems and inadequate attainment of management goals.

Research and Monitoring Needs

Protected area management cannot be truly effective without research and long-term monitoring of the ecosystem under protection. Thus, the establishment of protected areas should be accompanied by the initiation of research and monitoring. There is a long and particularly rich history of scientific research in Antarctica and the Southern Ocean, culminating in the SCAR initiated BIOMASS program (Biological Investigations of Marine Antarctic Systems and Stocks) now nearing completion, which is among the most ambitious international and multi- disciplinary ecological investigations ever mounted. However, the extent to which past research has been management oriented and has been assimilated into protected area management practice is somewhat variable.

While we now have the benefit of detailed reviews of existing protected areas, referred to above, there is still no comprehensive survey or checklist of natural landscapes, marine environments, and biota of importance and which should be protected. Achieving an effectively managed, expanded protected area system will require improved understanding of ecosystem dynamics and a further shift from species-oriented to ecosystem research. Appreciating the dynamics and "health" of Antarctic ecosystems in the face of a growing human presence will ultimately require commitment to long-term monitoring to reveal irreversible breakdown of the ecological system. Long term ecosystem monitoring is probably the most fruitful avenue for future research in Antarctic protected areas.

Requirements For Management Supervision and Expertise

Stewardship of protected areas is an awesome and difficult challenge in a region as vast, remote, hostile and poorly known as Antarctica. Day-to-day supervision by wardens, as commonly practised elsewhere, is impractical and unnecessary. But there is considerable merit in the suggestion that management committees be established to provide oversight of management, and as a vehicle for applying scientific, technical and administrative skills to Antarctic protected areas. Such committees have proven invaluable in some countries, and are already established for management of some southern islands, such as the New Zealand subantarctic nature reserves. Within the Antarctic Treaty Area an Antarctic Protected Areas Management Committee could be established, representative of Treaty nations, closely allied to SCAR and IUCN (among others) and with a mandate for promotion and coordination of planning and management measures for an expanded protected area network.

Conclusion

Antarctica is the most remote, barren and inhospitable of the earth's continents and is surrounded by a vast, stormy, though highly productive Southern Ocean dotted with far-flung island outposts. Geographical and ecological isolation, and harsh climatic conditions ranging from oceanic to continental and from cool-temperature to cold-desert, have created a unique assemblage of ecosystems. These are characterized by relatively impoverished floras and fauna containing few species (but huge numbers of seabirds in particular) many of which are endemic, specialized, rare and therefore of great scientific value. The Antarctic environment also has an indispensable role in maintaining the stability of the biosphere.

Antarctica is among the least man-modified regions of the world. Man has penetrated the Antarctic realm only over the last two centuries and his activities to date have largely been those of exploration and scientific research. Exploitation in the past has focussed on the harvesting of seals and whales but there is now unprecedented interest in fin fish, krill and mineral resources, and in the tourist potential of the region.

The Antarctic Treaty which arose in 1959 out of scientific endeavour, and is founded on the principle of conservation of the fragile Antarctic environment, has laid a firm foundation for the regulation of human activity over the continent and much of the Southern Ocean. It has proved to be an outstanding success in maintaining international peace and scientific cooperation in the region for more than 20 years. The treaty has also provided an umbrella for wide-ranging measures to protect the Antarctic environment.

However, Antarctica is now on the threshold of major decisions relating to the conservation and management of natural resources. Increasingly, the Antarctic oceans are becoming regarded as an important source of food for man, and a potential source of energy with possible, but unproven, hydrocarbon reserves. The Antarctic Treaty is silent on issues relating to resources primarily because when it was drafted their possible exploitation was a very distant and uncertain prospect. The Treaty has worked well in the absence of national aspirations over the development and use of commercially valuable resources, but it must now progressively evolve into a regime to cope with resource management. The issues are no longer purely scientific, they are becoming increasingly political and economic. The more recently developed CCAMLR is a bold initiative in establishing ecologically sustainable principles for exploitation of living resources, but its effectiveness has not yet been fully tested.

Development and use of natural resources introduce an urgent need to establish an effectively managed protected area system which is fully representative of the ecological diversity of the terrestrial and marine environments. Existing legal and policy provisions under the Treaty establish a sound philosophical basis for protection, and a promising beginning has been made in establishing protected areas, especially on the Southern Islands. However, the existing protected area system remains insufficient in both geographical and ecological extent, and it has a limited management focus which emphasizes scientific interest and uniqueness and/or rarity of biota. The nutrient-rich marine environments, in particular, are inadequately represented in protected areas.

There is much unrealized potential under the existing political and legal mandate for expansion of protected areas, using modern, scientifically based techniques adapted from experience elsewhere. Ideally, the ultimate protected area system in Antarctica will include a range of categories of areas, from securely protected nature reserves to multiple-use management areas where protection can be accompanied by compatible use and ecologically sustainable exploitation of resources. This is a formidable challenge but one which is too important to ignore.

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Human Implications of Arctic Animal Population Fluctuations: Caribou in Greenland

M. Meldgaard

Introduction

In Greenland, as everywhere in the Arctic, most vertebrate populations are subjected to fluctuations in numbers and to changes in distribution. The fluctuations and distributional changes in Greenland have been especially well documented for species exploited by the Inuit, for example, cod, salmon, ringed seal, harp seal and caribou (Meldgaard, 1983; Vibe, 1967).

The Greenland Caribou

At present the Greenland caribou is found in the central parts of (Figure 1) West Greenland from Paamiut in the south (61° 60′ N) to Nuussuaq in the north (70° N). By far the largest populations exist in the Sisimiut and Nuuk regions. In 1970 the total West Greenland caribou population had increased to a maximum of about 100,000 animals and it had spread into the previously uninhabited or very thinly inhabited coastal zone (Meldgaard, in press; Strandgaard *et al.*, 1983; Thing, 1984). Just ten years later, in 1980, the numbers had fallen to about 8000, a reduction of more than 90 per cent and the caribou are presently retreating to the inland areas near the Ice Cap (Strandgaard *et al.*, 1983).

These recent major changes in caribou population size distribution are by no means unique phenomena. Ethnohistorical, historical, and statistical sources that date back to ca 1700 AD document that similar population declines and related range reductions have occurred three times in West Greenland: ca 1750, ca 1860, and ca 1925 (Meldgaard,in press). Archaeological excavations of West Greenland caribou hunting sites indicate that caribou populations were unstable also prior to 1700 AD (Figures 2A and 2B) (Gronnow *et al.*, 1983; Meldgaard, 1983).

Based on this diverse source-material a number of statements can be made concerning the nature of changes in the West Greenland caribou populations.

Figure 1 Three caribou bulls from West Greenland. The West Greenland caribou populations fluctuate greatly in numbers. From 1970 to 1980 they declined by more than 90 per cent from a high of ca 100,000 animals to a low of ca 8000 (photo by Bjarne Grønnow, August 1982).

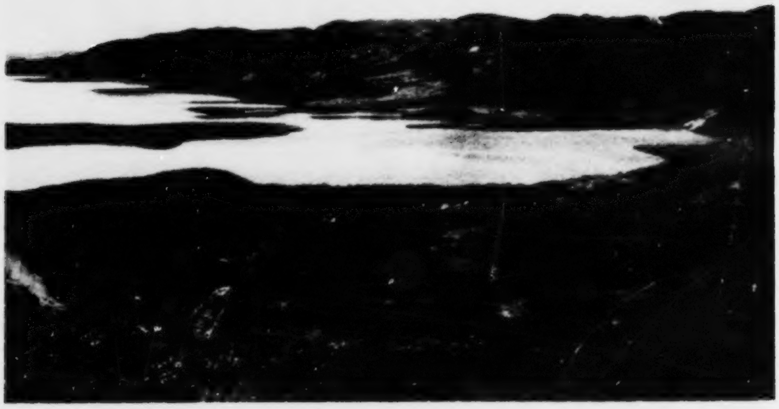

Figure 2A The caribou hunting camp Aasivissuit situated in central West Greenland has been used as a base camp by the Inuit for more than 2000 years. Archaeozoological investigations were carried out at the site in 1978 (Grønnow *et al.*, 1983, Meldgaard, 1983) (photo by the author, July 1978).

Figure 2B The eskimologist Jørn Berglund Nielsen excavating caribou bones at the caribou hunting site Aasivissuit (Figure 2A). Twenty thousand caribou bones from five time horizons provided information concerning caribou fluctuations and changes in Inuit caribou hunting methods (photo by the author, July 1978).

Population Size Changes

The duration of a population cycle may vary from ca 65 years to ca 115 years. The increase and the decrease phases are of rather short duration, usually ca 10 years. This is also the case with the maximum phase that may last from ca 10 to ca 25 years. The population minimum phase may, however, last longer, usually from ca 35 years to ca 70 years. The difference in population cycle length is thus primarily due to differing lengths of minimum phase (Meldgaard, in press).

The difference in population size at a population maximum and a population minimum is very great. The above mentioned 90 per cent reduction of the West Greenland caribou populations between 1970 and 1980 is a good example. Extinction of regional populations may result from such drastic declines. This was the case in Northest Greenland ca 1900 AD and in Southwest Greenland ca 1825 AD (Meldgaard, in press).

Distributional Changes

When West Greenland caribou populations increase in numbers they extend their annual migrations and expand their ranges into marginal previously uninhabited or very thinly inhabited territory. The expansion is primarily directed towards the coastal regions which are mainly used as wintering grounds. The summering areas and calving grounds in the inland areas are more or less stationary throughout the population cycle.

During population decrease the caribou abandon their coastal winter quarters, annual migrations cease, and they retreat to the inland areas where they make a living throughout the year. A simplified model of the fluctuations and the related distributional changes is presented in Figure 3.

Long-Term Population Trends

Superimposed on the above mentioned short-term population changes are long-term changes in caribou distribution. For example there has been a 50 per cent reduction in the distribution of West Greenland caribou over the past 200 years. And looking at Greenland as a whole there has been an even more marked reduction in caribou distribution through the last millenia, the extinction of the Southeast Greenland caribou ca 1200 AD and the extinction of the Northeast Greenland caribou ca 1900 AD being major events in this process (Meldgaard, in press).

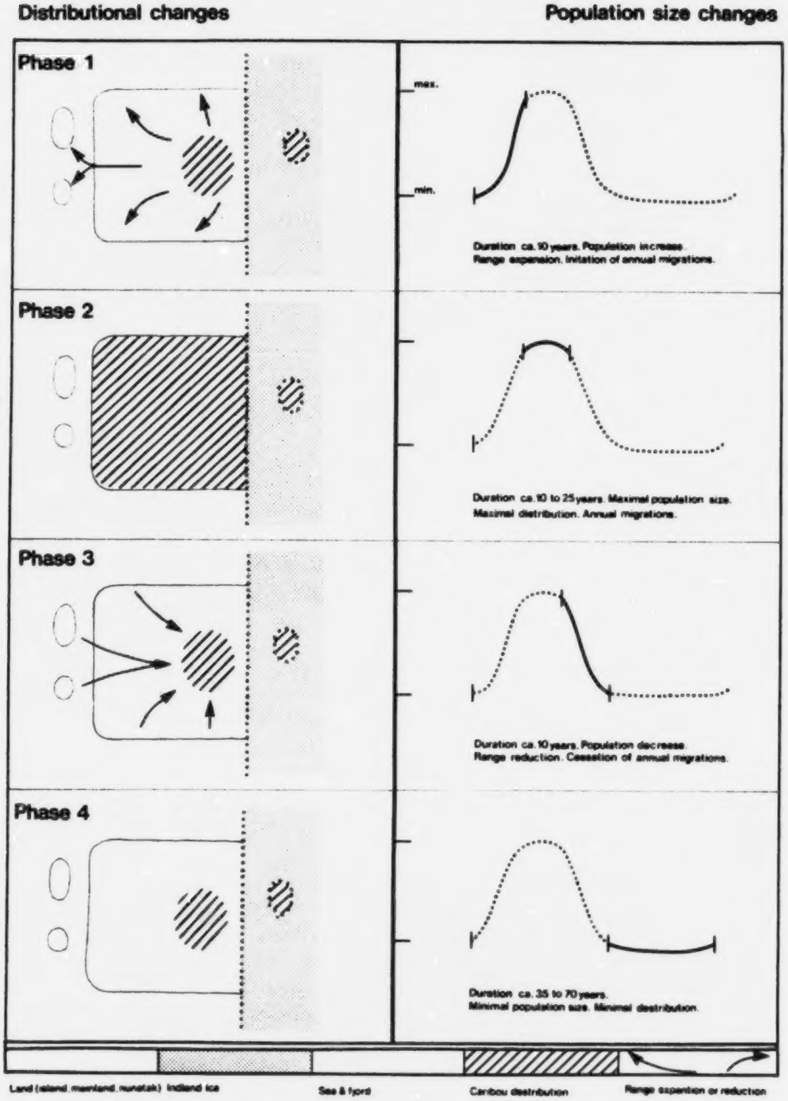
Distributional changes
Population size changes
Phase 1
max.
min.
Duration ca. 10 years. Population increase.
Range expansion. Initation of annual migrations.
Phase 2
Duration ca. 10 to 25 years. Maximal population size.
Maximal distribution. Annual migrations.
Phase 3
Duration ca. 10 years. Population decrease.
Range reduction. Cessation of annual migrations.
Phase 4
Duration ca. 35 to 70 years.
Minimal population size. Minimal distribution.
Land (island, mainland, nunatak)
Inland ice
Sea & fjord
Caribou distribution
Range expantion or reduction

Figure 3 Generalized model showing the interrelationship between distribution, abundance, and migration in a typical West Greenland caribou population (from Meldgaard, in press). Similar relations between caribou population size and distribution have been described from Siberia North America, and Scandinavia (Banfield, 1954; Hemming, 1975; Kelsall, 1968; Parker, 1972; Semenov-Tian-Shanskii, 1975; Skogland and Mølmen, 1980; Skoog, 1968).

The Causes of the Fluctuations

Hunting, overgrazing, and climatic change have been proposed as the major factors determining caribou population size and distribution in West Greenland, while factors such as insect harassment, disease, and disturbance are viewed as having a secondary regulating effect (Aastrup, 1984; Jennov, 1953; Strandgaard, 1977; Strandgaard *et al*, 1983; Thing, 1984; Vibe, 1967).

Several lines of evidence point to weather as being the proximal factor regulating population size, and accordingly changes in weather patterns become fundamental forces in the population fluctuations.

1. The regulatory effect of weather is clearly seen when sudden, often dramatic, die-offs occur as a result of severe climatic conditions. The Thule region caribou, the Inglefield Land caribou, and the Northeast Greenland caribou all experienced drastic population reductions and even extinction around 1900 following several winters with much snow and rain (Meldgaard, in press).

2. The fluctuations in geographically isolated caribou populations within West Greenland and within Northeast Greenland and Northwest Greenland have been synchronized through the last 250 years. Only climate can act simultaneously on such extensive geographical areas (Meldgaard, in press).

3. Meteorological observations covering the last 100 years document climatic changes in West Greenland that may be correlated to changes in caribou population size (Meldgaard, in press).

Resource Fluctuations and Human Subsistence

The fluctuations in the West Greenland caribou populations have had profound effects on Inuit exploitation of caribou. In periods with large caribou populations, caribou hunting played an important part in the annual subsistence cycle and caribou products such as meat, skin, sinew were much valued by the Inuit. But following a population decline and during a population minimum, caribou hunting practically ceased and more time and effort were spent fishing for species such as char and capelin and hunting for harp seal (Gronnow,in press *et al*, 1983; Meldgaard, 1983).

The traditional Inuit economy was based on a wide variety of resources making it flexible and well adapted to the dynamics of the arctic ecosystem. The decline of one resource could usually be dealt with by putting more effort into the exploitation of alternative resources.

This strategy has shown its viability in Greenland through more than 4000 years, and it would certainly be wise to introduce some of the basic concepts in this broad-based economy into present day management of living resources.

Historical Biology and Long-Term Research

The variability of arctic ecosystems presents politicians, wildlife managers, researchers, and others with some problems that deserve to be considered carefully. The West Greenland caribou populations go through population cycles that last from ca 65 to ca 115 years and in each phase of the cycle the interrelationships between caribou, caribou predators, caribou forage, and climate is different. A short-termed study of one of the phases will not be sufficient to describe and understand the dynamics of the caribou populations. Somehow the study must be extended to cover at least a whole population cycle.

The same problem is faced by most environmental impact studies made in the Arctic in connection with the exploration for and exploitation of oil, gas, and minerals. An investigation of, for example, three years may provide a detailed understanding of the biology of a particular area at a particular time, but such an investigation does not necessarily describe the situation during the following three year period.

There are two ways to go about this problem. One is to develop the field of "historical biology." Much biologically relevant information is stored in a diversity of geological, archaeological, historical, statistical, and ethnohistorical sources. The ethnohistorical sources deserve especially careful attention as they contain biological information that is based upon the experience of generations of people living of and with the arctic environment (Figure 4).

Long-term studies may be an alternative way to gain insight into arctic biological processes. The time perspective of such research programs should, for example, allow for the study of complete ecological cycles. In the case of the Greenland caribou, this would mean planning many decades ahead. In combination with historical and especially ethnohistorical biological research, such long-term studies will provide the best foundation for a better understanding of the processes in the arctic ecosystems and for sound management of the living resources.

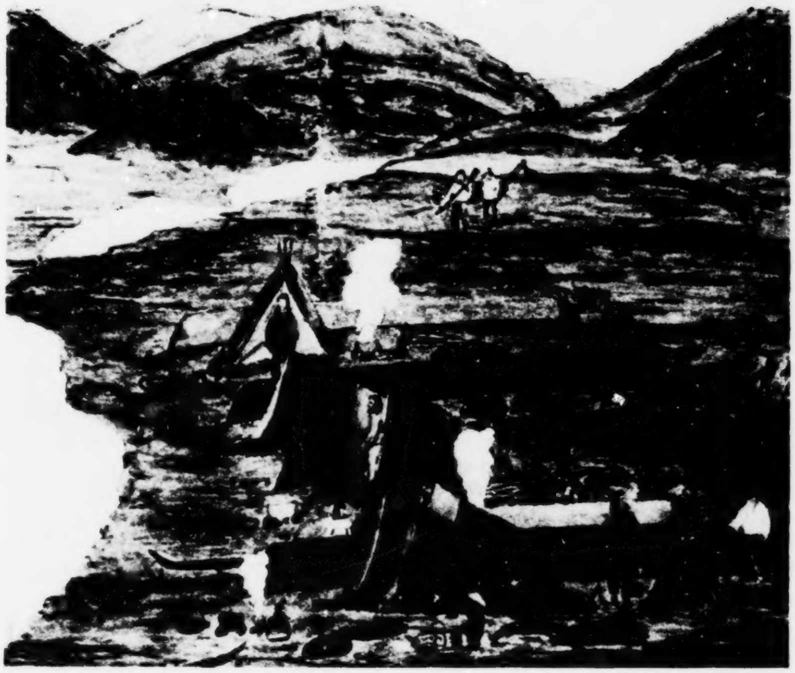

Figure 4 Angujaartorfik. A famous meeting place for caribou hunting parties in Sdr. Strømfjord, central West Greenland. The watercolour was painted from memory by the greenland artist and caribou hunter Aron of Kangeq (1822-1869). The watercolour gives a precise and very detailed picture of both camp life itself and of the landscape surrounding the camp. Aron's nineteenth century paintings provide an example of the Inuit hunters great powers of observation. It is very important that such ethnohistoric sources are used in historical biological reconstructions (the watercolour is kept at the Kalaallit Nunaata Katersugaasivia (Greenland National Museum, Nuuk).

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Indigenous and Traditional Forms of Northern Land Use: Their Role in Economy and Heritage

Kurt V. Abrahamsson

Introduction

Under the foregoing very broad and general title, an effort will be made to exemplify the transition from traditional, and indigenous, forms of land use in the north into the land use of today, by using one very common "economy," i.e. nomadic pastoralism related to reindeer herding. For most Old World arctic peoples, life has for a long time centered on reindeer. They were hunted wild and later domesticated. The New World reindeer, the caribou, was never domesticated, and has always played a secondary role for the coastal peoples. Some inland groups sustained themselves on caribou, fish and waterfowl, but the Inuit - coastal dwellers - subsisted on sea mammals like seals and walruses. The latter group developed a culture very closely tied to these animals, and the change from the old traditional ecotechnology went directly into the technology of the 1950s and 60s. Originally the population density was very low on the coastal tundra - e.g. the Netsilik Inuit (west of Hudson Bay) in 1923 numbered about 260, in a region 480 x 160 kilometres in size (Simmons, 1974). They needed that territory, because the carrying capacity, as related to their ecotechnology, was low. But by that same time, groups like the Yakuts, the Nenets, and the Chukchis of the Soviet Arctic, and the Saamis in Scandinavia, were well adapted to reindeer herding, and were able to live in settlements and reach much higher population densities. By tying themselves to the reindeer, they also had to adopt a nomadic way of life, and their culture developed accordingly.

Some Definitions

Included in the title are two words that we need to define, and there is some terminology related to land use that should be clarified from the outset. With indigenous, from the Latin - indigena - born in a country, native, one understands somebody or something that is native to, born or produced naturally in a region or country. The Inuit are indigenous to the Arctic region. Synonyms are original and aboriginal; the latter meaning "from the origin." The aboriginal people are the first inhabitants of a a country. In relation to our interest here, this term is not so important.

Traditional is related to "tradere," Latin for to deliver, to hand down. Traditional use of land means then using the land in the way the forfathers used to do, as handed down through generations. Land use is of course seen here in a very broad sense, a terrestrial area as it is used over time, both over a long period as well as during a year-cycle with a sequence of seasons.

Other definitions that are dealt with further on are pastoralism, nomadism and transhumance. These are all related to the carrying capacity and seasonal use of the land.

According to Yadeta (1985) the traditional usage of "nomadism" has a connotation which means living on pasture, derived from the Greek word "nomados." However, there is another term which is often used by different scholars, that is, "pastoralism" which has affinity to the word pasture. This implies that "nomadism" and "pastoralism" often are used interchangeably to define the same type of activities. However, it is apparent that "nomadism" has another meaning as well. It denotes both subsistence herding and wide spatial mobility, often in cyclical movements.

The reindeer herders of northern Sweden are traditionally nomadic pastoralist, and like many present day hunter-gatherers they occupy marginal habitats. The form of spatial mobility which has given them the epithet of "nomads" is related to the marginality of their resource base. But their dependence on domestic livestock sets them apart from hunters dependent on wild food (see Carlstein, 1980, for a thorough discussion along these lines). Pastoral nomadism is most often described in connection with dry habitat, e.g. in Africa, and best developed along dry margins of rainfall cultivation. But in the general sense, nomadic pastoralism is practicable in areas where the growing season is too short for domestic plants to mature, either due to lack of rainfall or where the temperature is too low. Johnson (1969) has put it this way: "Pastoral nomadism is a livelihood form that is ecologically adjusted at a particular technological level of the utilization of marginal resources. These resources occur in areas too dry, too elevated, or too steep for agriculture to be a viable mode of livelihood, and the nomadic pastoralist thus makes use of resources that otherwise would be neglected."

Yadeta points out that nomadism appeared in the palaeolithic age, whereas pastoralism emerged in the neolithic period, being related to the domestication of animals and plants. In other words, there are many types of nomadism having one common characteristic, i.e. spatial mobility in a time dimension (Yadeta, 1985).

Before we return to the use of technological level, we need finally to define the term transhumance. Transhumance is often simply defined as seasonal movement from a low to a high altitudinal region, but this meaning has become somewhat obscured by the many different varieties in different parts of the world. What we can agree on is that transhumance entails double trips due to climatic variations of two favorable pastoral ecological niches. Reindeer herding by the Swedish Mountain Saamis includes transhumance since they move between summer pasture in the mountains and winter grazing areas in the forested lowland.

On Resources, Ecotechnology and Carrying Capacity

It is now universally agreed that resources, or more specifically natural resources, are strongly related to the human society. Resources are an expression of appraisal, and represent an entirely subjective concept (Mitchell, 1979). "Resources are not, they become; they are not static but expand and contract in response to human wants and human action" (Zimmerman, 1951). So there exists a functional relationship, it is a culturally defined concept - "which hinges upon man's perception of the means of attaining certain socially-valued goals by manipulating selected elements of the biophysical environment." (O'Riordan, 1971). To the traditional Inuit society, seals are a very important resource. Some groups in the high Arctic could be said to belong to a seal culture, their whole existence depending upon the availability of seals and related species. And they had developed a technology related to seal hunting. Ground lichens, and more specifically, arboreal lichens, are a resource only for the Saamis in North Scandinavia. No other groups or part of the Swedish society has a real "relation" to lichens. They are not a resource for the "average" Swede today.

It has been argued that when societies are classified into categories as food collecting (hunting, gathering, fishing), agricultural or industrial, this is a classification according to technology. The main criterion is the social form of organization of production and consumption, an economic system. The term ecotechnology has been used (see e.g. Carlstein, 1980) in relation to societies in order to set the technology as an intermediate factor between ecology and economy. Different "societies" can be arranged in order of increasing complexity of ecotechnology. Moving from hunter-gatherer over pastoral nomads to urban-industrial societies, the focus will shift from interaction within the habitat to interaction within the population. Although the post-industrial society still is dependent on nature, the "advanced" society is dominated much less by coordination with the yearly rhythm of the natural environment, than by being in tune with the man-made, social environment. The shift in ecotechnology has taken place in all northern or arctic societies, but in varying degrees. This point will be discussed later on, as it is of great interest in regard to traditional land use.

The concept of carrying capacity has been discussed for quite some time now, being used by biologists, park planners and behavioural scientists. An early definition is provided by Dasmann (1945) who stated that carrying capacity (cc) could be defined as the maximum number of grazing animals that could be maintained in "good flesh" year after year on a grazing range without damage to the forage or to the soil. The concept also applies to the ability of land to support people. In this respect it can be interpreted to mean the carrying capacity of the land environment, sustaining human populations at given levels of technology and amenity.

Thus the carrying capacity of the land is part of the overall environmental carrying capacity (the other components deal with water and air). In turn, the ability of land to sustain human life at a "reasonable" level of comfort could be given in terms of its capacity to produce food or to provide mineral resources, energy sources or physical space, or any combination of these (Scott, 1975). Mitchell points out the difficulty in reaching an objective definition of carrying capacity. He notes that the final decision about carrying capacity is always an arbitrary one. Someone, somewhere, sometime, must decide what constitutes an undesirable change in vegetation and soils, or an unacceptable level of crowding or congestion (Mitchell, 1979). This is of course looking at the problem as a scientist's dilemma.

But that is at the same time only one side of the problem - it is still a question of a static conception of land use and related carrying capacity. Let us accept the assumption that the small hunting-fishing groups along the Arctic shores often were well below the carrying capacity of the environment in relation to their ecotechnology. One way of maintaining the population/resources equation could be through female infanticide - they knew the carrying capacity of their land and adjusted accordingly. They had, according to Wilkinson (1973) "settled down into a known and proven way of life, which allows them to deal with all eventualities without innovation." But if the population grew anyhow, if the control mechanisms did not work, then the society had to resort to innovative ways of intensifying land use and/or improving technology. As we will see later, there are other ways, e.g. emigration or shifting to another society with a different ecotechnology. This is of course what has happened both in North America and in Scandinavia, where indigenous people have left their original home area and some traditional land use and ecotechnology, and moved out "to the south." The ones that "stayed behind" are continuing to fight for their survival, often in a rapidly changing society, where the values are changing faster that the physical environment.

Terrestrial Space-Time, Capability Constraints and the Prism Habitat

A concept which is very useful in dealing with carrying capacity and land use is "time-space resources." The idea around the concept has been developed especially by Swedish human geographers, notably the Hagerstrand school in Lund. Carlstein (1980) expresses the relevant part for our purposes, in this way:

> The carrying capacity of terrestrial space-time can thus be defined as the limited ability of a given area to accommodate space-demanding people, organisms, artifacts, materials and the activities associated with them. Since space can be more or less continuously occupied over time, we must actually deal with terrestrial space-time (which may also be called settlement space-time for an area settle by people). The carrying capacity of space-time is thus a function of the spatial area and the observation period. This can be quantified in terms of square-meter-days for a building or hectare-years for the lands of an agricultural village.
>
> For any space-time region, there are limits to the packing of entities demanding space-time, as all living and dead things do. Unlike the carrying capacity limits of bio-ecology, these limits cannot be exceeded even temporarily, although a given regional space-time budget can be more or less densely or intensively packed.
>
> The space-time concept of carrying capacity can be applied at all scales from that of a matchbox to a region or the entire globe. It is thus pertinent to both rural and urban forms of land use, and covers all activities, not only those associated with food production, which is all that the traditional carrying concept is designed for.

In short this means that both space and time is limited - the day has only 12 (or 24) hours and man is indivisible. He cannot be at two locations at the same time, but he can speed up his travel by innovations. The introduction of the snowmobile to the Arctic Inuit society is the best example here: the most widely known might be the introduction of the horse to the Plains Indians and the connected extermination of the buffalo.

Individuals have limited capabilities to act: these are called capability constraints, and vary with age, sex, experience etc. To this must be added the already mentioned constraint of human indivisibility. Because of these constraints, most activities are mutually exclusive, the individual has to decide what to do, where and when. Many activities require special sites and setting, they cannot be performed elsewhere. The activities of a group of people are subject to a set of coupling constraints (cf. Hagerstrand, 1973). The necessity to get in contact with a number of people at a number of places during a limited time span causes stress in a travelling salesman, but a reindeer herder in Swedish Lapland actually works under the same type of constraints. When moving the herd he has to meet many coupling points in space/time, and the introduction of the automobile and snowmobile into herding makes the task easier in some ways, but as we shall see later, also more demanding in several ways. The time geographic model of society and habitat designed by Hagerstrand (cf. 1963) is what he called a socio-environmental web model. A cornerstone in this model is that the human population is looked upon as a web of paths which flow through a set of time-space locations.

> Fortunately geographic space can be represented on a plane. A human population living in the area which the plane represents, is supposed to have arranged several sets of "stations" serving its needs. The most important of these sets of stations are dwellings and places of work ... The stations can be represented on the plane as points ... Now if we add time (t) as a third dimension we get a picture of a simplified "time-space" ...(Hagerstrand 1973) (Figure 1).

One more component of the space-time model has to be included, before we move to the indigenous land use models and their contemporary counterparts. The time prism or prism habitat of an individual, or a group, is the visual expression of a time constraint. The idea of the prism needs to be expanded on in order that it can be used in discussion later. The description is after Carlstein (1980).

When pursuing an activity, the individual has a place or station of departure, which acts as a determinant on his immediate prospects for making use of other spatially localized inputs. The accessibility of these inputs is further determined by the individual's capability to travel, especially the constraints in his speed. The individual-path can only move outward within a time-space cone which is circumscribed by the maximum speed of movement from the point of departure. This potential action space looks graphically like a funnel, assuming that the individual can move in all directions at a uniform speed in a uniform landscape. For hunter-gatherers, for instance, speed on foot is slow, as is the case in any type of society. Assuming that an individual has to return to the same station at a fixed time, such as sunset, this coupling constraint circumscribes the area that can be covered, since the further out from this point one is, the sooner he must turn back to return in time. Hence one can speak of another funnel which is the mirror image of the former. The

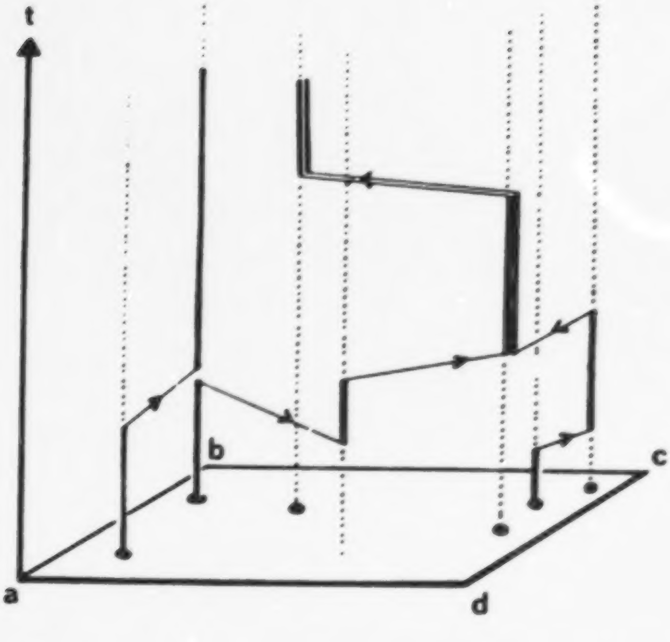

Figure 1 Three individuals in time-space. (Source: Hagerstrand, 1963).

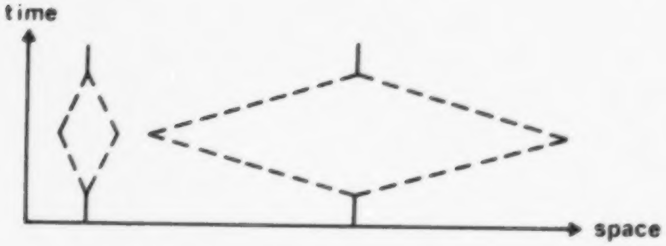

Figure 2 Prism size as a function of speed of travel (Left: walking. Right: horse- back riding).

action space of the individual is thus doubly delimited, and the resultant portion of time-space can be called a prism. The volume of the prism is defined by all potential paths of an individual when traveling at maximum or less than maximum speed. Only the time-space locations inside this circumscribed area can be used. The individual is "imprisoned" so to speak by his own capabilities of traversing space as well as by his own decisional constraint to be back at a given time. There exist a variety of capability and coupling constraints which result in prisms restricting the use and occupation of time-space in the settlement system. In most societies dwellings operate as the main station of return, but other stations have similar functions. Speed is another factor influencing prism shape. For instance, if one rides instead of walks, the maximum speed is normally increased, paths slope more horizontally, and the potential time-space covered increases correspondingly.

A determinant of prism size is the time distance between origin and destination, since a person covers a greater area in a longer time period than a shorter one, but the spatial distance between origin and destination also affects prism size and shape (cf. Figure 2).

As mentioned before, an increase in the spatial mobility, i.e. an expansion of the "prism habitat" (size and shape) can, and will in most cases, have drastic social and technological consequences. The Saami reindeer herder has thus, by using tracked and wheeled vehicles on the job, expanded his "prism," and that again has impacts on his social life and living standard, as we shall see.

Environmental Constraints in Arctic and Northern Land Use

The true northern and arctic environment sets some severe limits to human occupation and development of a culture. The ancestors of Man had developed their biological capacities in the warm low latitude savannas and forests, later dispersing into temperate and cooler regions. The Arctic was one of the latest major regions to be occupied. Here the development of an appropriate ecotechnology was of supreme importance. The population, e.g. along the North American arctic coastline, lived, by anthropological standards, at a generally palaeolithic level of technology and economic adaption until the time of European contact.

Among the environmental factors that limited the occupation in the Arctic, some are especially important, and it is in relation to them that the special ecotechnology was developed. The climate is seasonally very cold. Shelter in the form of clothing and housing had to be devised. The arctic does not provide plant food sufficient for maintaining human life. The people must hunt and fish: that means placing themselves at the top of the food chain or pyramid. There is seasonal scarcity even of animal foods. The prey species hibernate or migrate or are protected beneath winter ice. In most areas the number of prey species is very low, but they often occur in great number and seasonal concentrations, e.g. the caribou. A well developed predation technique, oriented towards only three or four species, was the answer. Finally, but not least important, was the limited supply of fuel and material for construction of shelter and the making of tools and weapons. Hides, bones, feathers, fat etc. were all extremely important animal products - products on which the culture depended.

To sum up these points, the dependence on animal foods and very few prey species meant that the people could not insert their economy at different levels in the food chain, but had to develop an ecotechnology in relation to seasonal migration of prey. They either had to move with the prey, or be able to store food in locations where the animals would be in great numbers once or twice yearly. Techniques were developed to store food in cellars in the permafrost. The deep freeze-age of today has a very early, and forgotten, counterpart in the traditional Inuit society. Drying of food was of course also common in early times.

The discussion above is related to traditional living in the true arctic. But many of the indigenous peoples of today, the Indians of the Canadian north and the Saami of Scandinavia, have developed their culture and traditional land use in a boreal, often partly forested environment. The constraints are not the same, but they are similar. The Saami have only relatively recently moved, or rather been forced, into their harsh environment, i.e. during the last two thousand years. So they have established their ecotechnology much later than the Inuit, the latter having moved to Arctic North America during the Bering Land Bridge era, starting from about 40 000 BC.

Reindeer Herding and the Traditional Land Uses in the North

Of the seventy or so groups that make up the indigenous peoples of the Arctic and sub-Arctic, the Saami, or Lapps, live in northern Fennoscandia within the territories of Norway, Sweden, Finland and the Soviet Union. Some of the others are the Inuit of Greenland, Canada and Alaska, the Aleuts, the Samoyeds, the Tungus etc. of Siberia, and the numerous Indian tribes of northern Canada.

All of these groups have developed viable social and economic systems in accordance with the prevailing natural conditions and cultures which have been handed down from one generation to another without the aid of any written literature. Comparative studies of these peoples have shown them to have arrived independently at social organizations based on family, kinship, and hunting groups with collective utilization of the land. They have evolved similar patterns in both their material and intellectual culture. Their activities, centered upon exploitation of the natural environment, are generally organized into a rational culture geared to maintaining a permanent energy cycle (Siuruainen, 1980).

Reindeer Nomadism - Reindeer Herding

It is often said that the Saami, as the indigenous people of northern Fennoscandia (the term includes Norway, Sweden and Finland) have been herding reindeer for thousands of years. But using tame reindeer in the household economy and herding reindeer is not the same thing. We should keep the terms husbandry and herding apart, but they are often used interchangeably in describing nomadic pastoralists. But there is a difference. The word husbandry means management of domestic affairs or resources, while herding means to tend or drive as herdsman. But Paine (1972) adds explicit distinction between the two concepts. For him husbandry is the relationship between herd and consumer, while herding is the relationship between herd and pasture - the state of control of herds during their grazing process. The term to be used in describing land use is consequently herding, as it is related to the use of land and the system of migration - the nomadic part of herding, that in most cases is the one being affected by changes in the outside world.

The Saami have probably used tame reindeer for several thousand years, at least since ca 800 AD, when it is certain that tame reindeer husbandry was practised in Norway. But the tame reindeer was used for a long time solely within the frame of a society in which the basic forms of livelihood were hunting, fishing and gathering. Only a few tame reindeer were used, both for transport and as decoy animals in hunting wild reindeer. It was not until the seventeenth and eighteenth centuries that tame reindeer became the economic basis of the Saami society. The social formation which then arose is called reindeer nomadism (cf.Lundmark, 1982, Vorren, 1977). Domesticated reindeer had been used by Saami groups in the late sixteenth century. There are tales of rich Saami leaders having slaughtered "thousands of reindeer," selling meat on the market in northern Norway. But these might have been wild reindeer that had been killed in the mountains. The efficiency in the hunting of wild reindeer - as the Saami were successively forced to pay higher taxes to the state authorities - is considered to be one of the important factors that led to domestication, and later herding, of reindeer in Fennoscandia. The domestication and herding had profound effects on their Saami society, but has also led to different types of reindeer economy in different parts of Fennoscandia and northern Soviet Union.

Even if the general theory of reindeer herding as associated with nomadic movements between seasonal grazing areas is accepted as the "classical" one, there still exists several types of herding. A classification can be made in relation to the natural environment and according to the intensity of herding. As related to the environment we can distinguish three types: the interzonal or transhumance herding of the Mountain Saami in Scandinavia, the tundra herding with movements only on the lowland tundra, and finally the forest herding where the animals stay in the taiga or boreal forest year round. According to intensity in herding the types are: completely regulated herding, called intensive herding; the type calling for less observation and guarding, called extensive herding; and finally hyper-extensive. The last type can be exemplified by the operations of NANA Regional Corporation in western Alaska.

The transhumance and forest herding types are both common in Scandinavia, while tundra herding of intensive type is common in northeastern Soviet Union (Tjukotka, Korjak).

In the following section a closer look will be taken at some of the herding areas.

The Finnish Situation

When the Finns moved into their present territories from the south around 2000 years ago, the area was already occupied by Saami villages, or siidas. It would seem that each extended family had collective rights over lands for hunting, fishing and the gathering of produce which were assigned at a meeting of the heads of families in proportion to their respective needs. These families would usually have separate dwelling places for each season of the year, which were similarly used for hunting, fishing and gathering the fruits of the earth.

The increase in the Finnish population led to excessive pressure on the game forests and fishing waters of Saami villages, and this together with the effects of the "slash and burn" style of cultivation practised by the early settlers, would appear to have promoted a retreat of the Saami towards the north. Concurrently there was a spread of permanent Finnish settlement in a northerly direction encouraged in the 18th century by the state of Sweden-Finland which offered tax concessions and freedom from military service to settlers in order to stake its claim to these areas. Attempts made to convert the Saami to Christianity and the decline in game stocks, appears to have led to their retreat to previously uninhabited regions of the Far North. The late nineteenth century saw a rapid decline in wild forest reindeer, their most important game animal, which forced the Saamis to either intensify their fishing and reindeer herding or transfer to agriculture and forestry as a means of livelihood in the manner of the majority population (cf. Siuruainen, 1976 and 1980).

Within Finland, the Saamis presently inhabit the three northernmost administrative districts, or communes: Enonekio, Inari, and Utsjoki, and the northern part of Sodankyla. This area accounts for about 90 per cent of the total Saami population in Finland, but it is only in one commune, Utsjoki that they constitute a majority within the local population (amounting to 57 per cent).

The earlier nomadic reindeer herding tradition has now been exchanged for permanent settlement and reindeer rearing within the confines of Reindeer Herding Districts. At the same time, of course, many Saami have turned away from reindeer herding entirely, changing to agriculture and forestry, or they make their living from some form of paid employment. But reindeer herding is still of crucial importance as far as incomes of the Saamis are concerned, since about 40 per cent of Finland's over 200,000 reindeer belong to the herding districts of the Saami areas, and 85 per cent of these are owned by the Saami themselves. It is, in fact, only in the Saami area of the country that reindeer herders regard themselves as deriving their main income from reindeer, whereas elsewhere reindeer herding provides what amounts to a subsidiary income only.

What makes the situation in Finland unique is that reindeer are owned and "herded" also by the majority, i.e. Finnish, non-Saami population in northern Finland. The obligations and rights of reindeer management related to land use are determined in the Reindeer Management Act, issued in 1932 and revised in 1948 and 1968. In the reindeer management area, which is somewhat larger than the county of Lapland, all grounds outside the largest cities are regarded as reindeer ranges, regardless of whether the area is divided into 55 Herding Districts each belonging to a herding association or is divided into 14 "brand districts" (ear markings). Every Finnish citizen living in the reindeer management area, who is a member of a herding association, has the right to own reindeer. The state charges every herding association a formal range payment annually, which is, however, returned to The Association of the Herding Associations to be used for reindeer research.

Every herding association has a so-called highest permitted reindeer number. The number is determined for ten years at a time by the State Council upon proposal of the County Government, which hears the herding associations and land owners. The actual number is usually below the highest permitted number, and the total number today is around 270,000 reindeer in Finland. In the case of over-grazing, or if reindeer management cannot be considered otherwise reasonable, the State Council has the right to suspend reindeer grazing in a given area for some time.

The value of the reindeer industry in Finland can be gained from the following facts, obtained from Helle (1985). The data are for the county of Lapland, which comprises about 82 per cent of the total reindeer management area.

In 1980 the output value of reindeer husbandry was about FIM 30 Million. In the same year, the delivery value of timber was FIM 520 Million, the total turnover of forest industry being FIM 2, 100 Million. But it is commonly noted that the value of reindeer husbandry as employer is greater than expected on the basis of its output value. About 3000 reindeer owners participate in managemental work, carrying out about 330,000 working days; this equals 1650 full-time jobs. In forestry, actual forest work and short-distance transport provides 4000-6000 jobs in the same area. One should also know, that many of the reindeer owners have a forestry property as well. In the central and southern part of the area, incomes from the forests were 19 per cent of the total income of the reindeer owners.

Besides the possibility for any Finnish citizen to own reindeer, which makes the situation in Finland exceptional, the other special feature is the division of the management area into small herding districts. Accordingly there exists no true reindeer nomadism in Finland - only husbandry and herding inside limited areas: no transhumance, but forest herding of the extensive type. The grazing within the districts is done using a rotational system, whereby the carrying capacity (cc) is depending upon the use of the total biomass available in the district. The carrying capacity is thus largely dependent on the availability of three food components: reindeer lichens (*CCladonia ssp.*), arboreal lichens (*Alectoria, Bryoria and Usnea ssp.*). and a grass, Deschampsia flexuosa. The general pattern is, that the grass is eaten in early winter, the arboreal lichens in the late winter. How long the reindeer herds can rely on Cladonia-lichens varies between the districts. Only in the northernmost part of the area, where the lichen biomass averages about 200 kilograms per hectare or more, are the reindeer capable of using lichens throughout the winter season. Elsewhere they must begin to eat arboreal lichens in mid-winter.

As the reindeer herds in Finland use the forested area, except for parts of northernmost Lapland with tundra, one of the main land use problems is related to forestry. The actual total effect of modern forestry upon reindeer herding is under study in Finland. One relation which is proven is that forests containing arboreal lichens in abundance are generally older that 100, or even 150 years. Since the 1920s, the area of the old forests has decreased in Northern Finland by about 50 per cent. In the central and southern part, the reduction of old forests has been more drastic that this general figure suggests; actually forests with arboreal lichens have been almost totally lost in many herding associations. In the short term, forestry fellings provide the reindeer with a rich source of food, and felling of old spruce trees just for the reindeer was a normal custom before forests came to be of commercial value. In the 1970s, felling areas supported about 10-20 per cent of the total reindeer population. In practice arboreal lichens are a non-renewable resource, since most of the old spruce forest (the best lichen forests) have been regenerated with pine. The present rotation time is too short for fully developed arboreal lichen vegetation.

The total effects of modern forestry, hydroelectric development, dams flooding and seasonally flooding and conflict with the expanding tourism in Lapland, was that in the late 1960s, most herding associations located in the southern half of the area found themselves in a situation where two alternatives existed. They either had to reduce the number of animals in order to conform to the actual carrying capacity of the winter ranges, or compensate for range losses through "artificial" feeding. The method of supplementary feeding was adopted, and the result has been a constant increase in animal number, despite a simultaneous decrease in the area of old forests. At present, the reindeer population size, production, and also the value of meat produced, are at a higher level than ever before in the history of Finnish reindeer management. About one-half of the total reindeer population obtain dried hay as supplementary food on natural ranges even in winters with normal snow conditions. Especially in the southernmost herding associations another practice is followed: after the round-up period, the reindeer are gathered into small yard-corrals, where they are fed for at least three months during the winter.

The transition to corral feeding requires extra money from other sources. This is possible only if reindeer herding is a secondary livelihood, which is actually the case in most instances in the southern half of the area. In addition, most "corral feeders" admit that the reindeer represent for them more an element of quality of life, than an economic necessity.

After this rather extensive account of reindeer herding in Finland, let me finish with a citation from Helle, where he reflects upon the future of reindeer management (Helle, 1985):

> As the majority of the reindeer owners are of Finnish origin, with attitudes and values that are "typical" for the Finnish life style, reindeer management in Finland cannot point to its cultural value as ostensibly as in Sweden and Norway, where reindeer management is a privilege of the Saami minority. This has meant in land use allocation, that reindeer management has been forced to prove its compatibility by quantitative measures, i.e., in monetary terms. Therefore, the administration has encouraged and favored management practices which increase meat production. This has been without doubt a proper policy, in as much as it has stressed the importance of an optimal sex ratio in reindeer herds and at calf harvest, and the placement of the round-up season to autumn and early winter. At present the idea of competitive reindeer management has met with difficulties, since maximization of meat production has led to economically unhealthy over-feeding.

> One can forecast that this will be reflected in turn in the status of reindeer management in land use allocation: unprofitable reindeer management is ranked in the same category as hunting, which is only occasionally taken into account in discussing forest area use.

Conclusions: The old Saami tradition in reindeer herding, with some nomadic movement in the northern tundra region combined with fishing on the Arctic coast, came to an end with the closing of the Finnish-Norweigian border to reindeer herders in 1852. The border with Sweden was closed in 1889, which in turn led to an outmigration of a part of the Saami population in northernmost Enotekio (NW-Lapland) to Sodankyla (eastern Lapland) in order to ensure adequate grazing areas. But it was, together with the effects of the border changes, the change over in 1898 from the open, nomadic, family grazing of reindeer to the herding district system introduced by the Finns, that finally changed the traditional land use of the indigenous people of Finnish Lapland.

The traditional land use, based on reindeer nomadism, has almost disappeared, and as reindeer are kept by non-Saami to a great extent, reindeer herding is not really a part of traditional land use in Finland.

Finally, modern forestry combined with other land use forms related to the modern, industrial society of the "majority" people, has forced reindeer herding into a system of corral feeding - we are moving back to reindeer husbandry with very little of herding and no nomadism at all.

Reindeer Herding in Expansion - The Norwegian Case

Reindeer herding in Norway is regulated by the new Herding Act of 1979. Reindeer herding can only be practised by Norwegian Saami within the reindeer management area. This area consists of Norway north of Trondheim - Roros (63° N). Outside the management area the Saami have no monopoly on herding, and there are some domestic herds in Oppland, in the southern highlands. Inside the management area all land, as in Finland, is treated as reindeer range, regardless of ownership. The management area is divided into six sub-areas and there again into herding districts. The number of reindeer varies between around 65,000 in Vest-Finnmark county and 10,000 in Nordland county, the total population of reindeer in 1983 being around 185,000. In 1975 the number was 138,000, so the increase in number of deer is strong. This is to some extent also reflected in the number of people engaged in and the jobs provided by reindeer management. The number of people having reindeer herding as their main occupation has remained the same, about 2000, between 1975 and 1982. But during the same period the manpower/man hour invested has increased from 500 to around 860 full time jobs (compare this with the figure 1850 in Finland, related to 270,000 reindeer).

But is reindeer herding/husbandry so much better in Norway, i.e. is the increase in jobs provided by the "reindeer industry" a reflection of good management and/or good grazing and herding? The answer is not quite simple, but one thing is clear: the state supports the industry substantially. In an agreement between the state and the Reindeer Herders Association, signed in 1976, it is expressed that using the natural resources of the country in best possible ways is a distinct goal. This intention includes maintaining the carrying capacity of the land and at the same time providing the reindeer herders with equal opportunity for attaining the standard of living that the average Norwegian enjoys. In monetary terms this meant that during the fiscal year 1982/83 41 million Nkr were paid to the reindeer industry (NOU:1984:21B). That comes out as about 46,000 Nkr per full time job in the industry. It has been pointed out that the efficiency must be improved, and that the production of only 10 kilograms of meat per reindeer (in 1983) should be increased to 15 - 17 kilograms per deer. Fifty-eight thousand, eight-hundred and sixty reindeer were slaughtered in 1982. The great increase in number of reindeer per district has also brought the discussion of carrying capacity back. We must limit the number of deer but increase the production of meat per head.

The Norwegian reindeer herding still has strong ties with the old tradition of nomadism. In northern Norway the herds move between the high tundra and the coast. The cyclic migrations, starting out in late April and returning in October, have recently been described by Bjorklund-Brantenberg (1981) in connection with the damming of the Alta River, and by Aarseth-Kalstad (1976) from Skaididuoddar in northernmost Norway. The main conflict in both cases is the damming of lakes and rivers and construction of new roads related to hydropower developments. There are no forestry operations and few other disturbances to reindeer herding.

Conclusions: In Norway reindeer herding is still mainly done in the old traditional way and related to a nomadic or semi-nomadic land use with migration between the tundra and the coast. This is the transhumance type, and at least partly done under intensive herding. The long migrations between the grazing niches in the system is disturbed above all by hydropower construction. And finally, the herding is still tied to the indigenous people, the Saami of northern Norway, but they are supported by the state in order to enjoy a reasonable standard of living in relation to their way of life.

High Mechanization - High Mobility: Swedish Herding of Today

The Swedish reindeer herding area covers roughly the northern half of the country (Figure 3). The area is divided into 52 Saami villages, "Sameby," the term village used both in relation to the area available for grazing/herding and as a cooperative, economic unit comprising a few families. The total reindeer population is around 220,000. About 2,500 Saami people are directly involved in herding, and only Saami can herd reindeer. But at the same time only the Saami actually engaged in reindeer herding have any special privileges above those of the general Swedish citizenry. The special rights were granted to preserve Saami culture (equated simply with reindeer herding), and to the extent a Saami strays from this livelihood, to that same extent must he give up his special rights. While in Sweden only Saami have the right to be eligible as herders Paragraph 1 of the Swedish Reindeer Herding Act of 1971 limits eligibility to those Saamis whos parent or grandparent had herding as a steady livelihood. Paragraph 9 of the same Act constrains the cooperative Saami herding entity, the Sameby so that the Sameby can engage in no economic activity other than herding. As the number of herders supportable by the Sameby, with its pure herding economy, continues to diminish - largely because of Paragraph 9 - the number of Saami eligible to become herders also diminishes according to the rule of Paragraph 1. In time, the number of people eligible for Saami "privileges" will be cut back to a vanishing point. Already there are only about 900 active herders in all of Sweden (Beach, 1985).

Although reindeer herding in Sweden faces the same problems in land use as in Finland in general, e.g. confrontations with forestry, I would like to concentrate on hydropower developments as a typically Swedish problem.

The mountain Saamis and their herds (some 80 per cent of the total reindeer population) migrate long distances between the summer pastures in the mountain areas and the winter pastures down in the forest by the coast. The forest Saamis migrate shorter instances, but still cover considerable areas.

Long migrations are a means of utilizing the areas giving the best reindeer pasturage at different seasons of the year, and reference is accordingly made to winter, summer, autumn and spring pastures. The size of the reindeer population is usually restricted by the availability of winter pasturage.

The reindeer herds are collected from their summer and autumn pastures for the September slaughtering, after which they are turned out into their autumn pasturage, and later move or are transported to the winter grazing areas. Spring migration starts in April, and the calving country is reached in May. Between June and August the reindeer graze on their high summer pasture, where the calves are earmarked. Long migrations usually proceed by stages and often make use of extensive and readily passable features in the landscape, such as swamps, lake shores and river valleys. A frozen river can provide a suitable migration route. Swamps and high ground can be used for overnight resting or as collecting points.

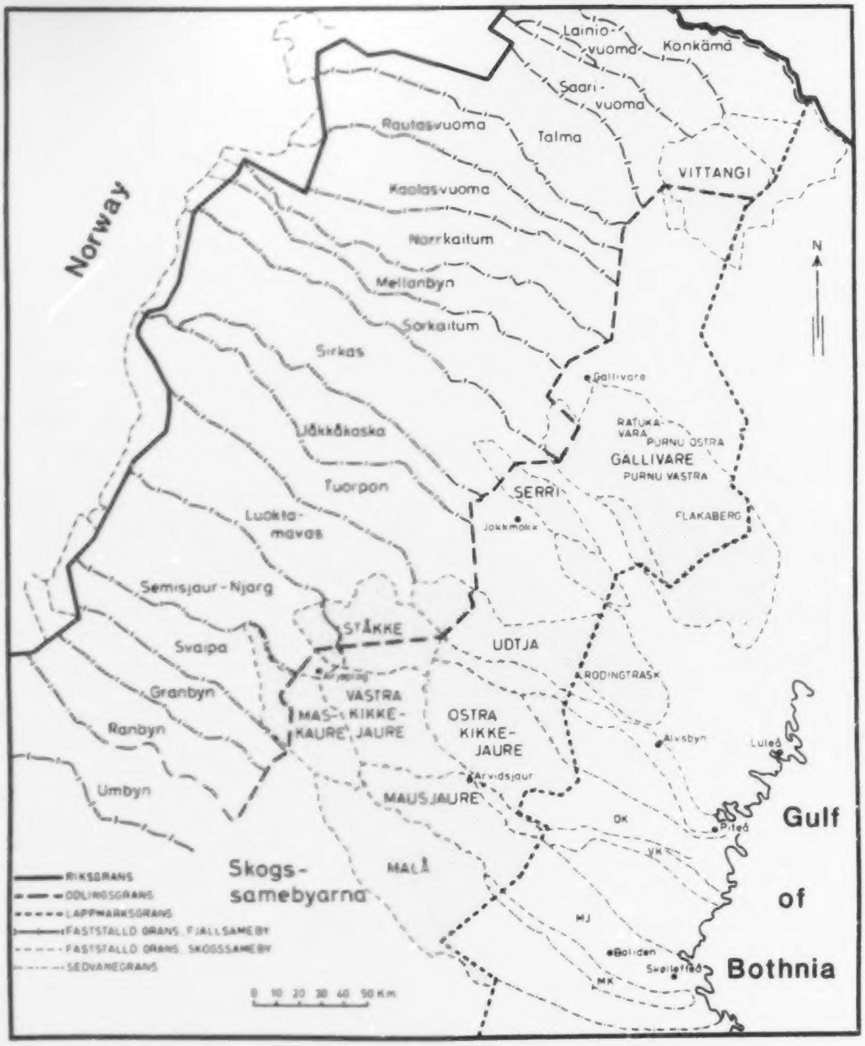

Figure 3 The reindeer herding area in northern Sweden, divided into mountain and forest (stippled) 'villages.'

The movements of the reindeer herd are influenced by weather and grazing conditions. Abundant snowfalls, late ice formation, a hot summer, etc. can make it necessary to use different migration routes from those which have been regularly followed for many years. For this reason, alternative routes and pasturage are needed even in areas not regarded as traditional reindeer grazing areas.

A river and its valley can provide the herding with a natural boundary, grazing, collecting areas, calving country, hunting grounds and fishing waters. In and between the river valleys there are pasture lands of various kinds which are needed and used according to the season of the year and the grazing condition. River valley pasturage is particularly important during winter and spring. The open lowland areas bordering the rivers have a thin snow cover in winter which disappears early. Furthermore, the low lying areas of the river valleys are often important rallying points for reindeer herds prior to migration.

In wintertime, a frozen watercourse can be used for migration, and the low lying parts of the valley often present favourable snow conditions, with a thin, porous snow cover. Without access to low lying country of this kind, the reindeer are liable to starve, because the snow covering pasturage at higher altitude is liable to freeze if there is a turn in the weather, rendering the ground vegetation inaccessible. The snow on the southern slopes of the valley melts quickly, and for this reason it is common for a river valley to provide both spring grazing and good calving country.

Thus reindeer herding has been adapted to utilize the natural conditions presented by the river valleys. This is why serious conflicts usually occur between hydropower interests and reindeer herders. The effects of interference with the grazing are often hard to predict. The reindeer is only partially tame, and changes in the behaviour of the herd cannot be reliably predicted.

Hydropower development can impede herding in many ways. Flooding can destroy reindeer pasturage, migration routes and technical facilities, but it can also be an indirect cause of damage, for example by impairing the size, location and interconnection of grazing areas, making them more difficult to utilize. This type of damage persists in the long term. There are also transitory difficulties occurring while dam and road construction is in progress and in connection with the adjustment of herding to the new conditions applying as a result of hydropower development.

The land use conflicts between reindeer herding and forestry in Sweden are best described by Mattsson (1985), and will not be dealt with here. Other competing uses of land are peat extraction, mining, new highways, air fields, summer and winter cottage developments, alpine skiing, etc.

Conclusions:

Reindeer herding is still going on as in "the old days," i.e. the nomadic movements between seasonal grazing areas are maintained in many areas. But the restrictions to stay within the "village" boundaries and some traditional common ground along the east coast, makes it more and more difficult to deal with the encroaching "industrial society," moving in from the south and east.

Some new "bottle necks" in the nomadic circulation are appearing, such as the expansion of urban areas, sometimes in combination with mining and winter sports facilities. These developments are cutting off the traditional migration routes, and the herders have to resort to other means. One such "invention" is the trucking of reindeer past the "bottle necks," or trucking them all the way from the mountains to the coast. But that is an expensive operation.

Especially in Sweden, but also in Finland and Norway, the ecotechnology is greatly modified in the way of transport and methods of communication. The herding is highly mechanized - cars, trucks, tractors, snowmobiles, motorcycles and motorboats are used as well as field radios. Even helicopters are used in driving the herds into corrals for earmarking and slaughtering.

By using cars and snowmobiles in the herding, the Saami are able to greatly expand their "prism habitat." Thereby they have been able to establish themselves, and their families, into only one place of dwelling, a year-round, modern home.

This central place of operation is usually located within the fall and spring grazing area, close to the mountains for the Mountain Saami, and with a central location in a Forest Saami village. This more permanent settling of the former nomadic society into smaller urban centers has a profound effect upon the Saami population in the form of obtaining social service, schooling, etc. at the same level as the rest of the society.

Meat and Antlers - The North American Way

Let us have a very brief look at the way reindeer herding is practised in northwestern North America, in Alaska and the Mackenzie Delta area.

In the 1890s Bering Sea coast natives, who had almost devastated the wild caribou with their newly acquired repeating rifles (introduction of new technology), were introduced to reindeer herding for subsistence. In 1891 the first reindeer were brought to Alaska from Siberia, and in 1897 the herd numbered around 1500 deer. It all started around Teller and Nome. Saami herders were brought in from northern Norway, and soon they were able to start their own small herds. But we have come a long way since, and today most of the herding is confined to the Seward Peninsula and surrounding area in western Alaska. In 1932, the peak period, the reindeer population was estimated at about 640,000 head. Protectionism by US cattlemen, the Depression, and range-management problems killed a promising industry, and in the late 1970s the total number was down to around 24,000 head.

The most recent observations on the current problems facing the reindeer industry in Alaska are made by Beach (1985) in his studies of the NANA Corporation. The herds seem to be well below carrying capacity of the range, and the herding type is the so called hyper-extensive. Some deer are slaughtered for their meat, but the main object of the industry today seems to be the antlers. The reindeer are rounded up for dehorning in early summer, released and then again rounded up and slaughtered in early winter. It is common for one man to hold the grazing permit to an entire range; he will hire workers from his village, and pay them in cash or meat. In general, there seems to be little incentive for good herding. Beach explains the situation in the following way:

> There are good reasons, however, for this state of affairs. The quality of herding must be evaluated in terms of the goals desired, and time spent achieving one goal is time diverted from the achievement of another. I know of no Alaskan herd owner today who would be destitute without his reindeer. While some families have herded for generations and it is an essential livelihood for them, yet even if they totally lost heir herds, I doubt anyone would seriously have to consider relocation or face poverty. The private herding families in Alaska were frequently rich and influential even before adding herding to their repertoire. The simple fact is that the Alaskan bush provides a wealth of food to the Native subsistence user who knows how to utilize it. Most of the time the reindeer owners can do much better for themselves by hunting than by herding. Salmon are overabundant in the summer; the tundra can be covered with berries; the air is full of birds both spring and fall; the sea provides walrus and seal, even whale (by limited quota). Traditionally the Inupiat have always been hunters and gatherers. Their villages along the coast and up the rivers are located on the basis of hunting feasibility rather than reindeer herding. The limited market for reindeer meat and the poor price it brings, do not permit the herd to be the major source of funds for the Alaskan Native herders that it is for the Saami herders in Scandinavia.

The Western Arctic Caribou Herd nearby numbers about 170,000 head, and with an unrestricted bag limit on Caribou, the Native can hunt caribou from his camp or home village and does not need to buy reindeer meat.

But the rapidly growing caribou population, up from 60,000 in 1970, offers a threat to the NANA Corporation's 4,000 to 8,000 reindeer. As the caribou herds pass by, semi-domesticated reindeer are drawn away to the passing herds. What will happen during the next decade in Alaska is an open question.

Reindeer herding in the western Canadian Arctic has a similar background as on the Alaskan side. As the whaling industry collapsed in the Beaufort Sea, some new source of income and/or meat was needed, and 3200 reindeer were bought in Kotzebue in 1929 and moved to the Mackenzie Delta. When the herd arrived in 1935 it had dwindled to 2,400 head. By 1960 the size of the total herd was around 7,000 head, but was again down to 2,700 in 1967, when the Federal Government decided to take over from the contract managers. The more recent development is described by Nasogaluak and Billingsley (1981) who took over the business in 1977. In 1980 the herd was up to an all time high of 13000 head, and continued to grow.

There are several reasons for this rapid increase in the herd size, and some of them can be singled out as more important. During the time since 1977 the Dempster Highway was opened, linking the Mackenzie District to southern Canada via the Yukon Territory. This permitted trailerloads of meat to be taken south to a much larger market. Also during this period a new "cash crop" emerged, namely the sale of deer antlers to the Orient (cf. Alaska). This market made it possible to carry out a summer round-up using helicopters for herding and with up to 40 workers at the corral. The new cash-flow also resulted in the purchase of an airplane for herd surveillance and other equipment.

The concern now is whether the range will be over-grazed in certain areas. On the permafrost, regeneration after overuse is very slow and can take 30 to 40 years. Investigations are under way to determine the carrying capacity of the range in accordance with the new herding techniques. So far the oil and gas exploration activities on the Preserve has not had marked negative effects on the reindeer, but this might change if some wells will go into production. Potential pollution of the air, as well as the shore-line, might affect the reindeer habitat. And finally, land claims settlement can close parts of the Preserve for reindeer herding on a large scale.

Conclusions: In North America reindeer herding and associated land use is not a traditional form of usage. The Natives have no tradition of migrating with the herds, and the alternative, close herding on the tundra, has never become an attractive way of obtaining the necessities of life.

In Alaska, the new cash income from the deer antlers has helped the industry, but it is still easier to hunt caribou when they pass by once or twice a year - the traditional ecotechnology is difficult to leave as natural resources are plentiful.

In the Mackenzie Delta area, the reindeer industry is of course based on the same environment, same pastures, as in Alaska. But for the reasons mentioned, the rangeland can be used very effectively - in much the same way as in Scandinavia today. A new ecotechnology is introduced, a surplus of products provides cash income, and very few Natives are living "off the land" in combination with reindeer herding. They are able to live in settlements like Inuvik, Tuktoyaktuk and Reindeer Station. But with the new techniques introduced in herding, there is a threat of overexploiting the rangelands - the carrying capacity is close to its limit.

The Inuit were never nomads in the true sense, and they never have adopted the role of using the land as nomadic pastoralists. They have increased their spatial mobility, but mostly along the coastline and on the sea ice - their traditional habitat.

Summary and Conclusions

The tundra, or barren lands, and the taiga with coniferous vegetation in a belt varying in width to the south thereof, have the same resources and the same carrying capacity for hunting and nomadic herding all around the Arctic basin. But there is a marked difference between the Old World and the New World in the way the land is being used. The Eurasian arctic and sub-arctic peoples tamed, or domesticated, the wild reindeer some hundreds years ago. The animals had to retain a certain portion of "wildness" (the Saami refer to 75 or 85 per cent tameness), as it is an essential quality for the important annual migration between grazing habitats. The peoples would half-follow, half-lead the herds between the summer and winter pastures, thereby exploiting the niches necessary in the cold environment. The winter grazing areas south of the treeline offered shelter for the people, but they needed to get back to the coast for fishing and hunting during the summer, while the herds were grazing on the nutritious grasses on the tundra, or barren mountains in Scandinavia and the Urals.

The intensive herding in "the old days" forced the herding people to follow the herds, to become true nomads. The whole family would move between summer camps and winter quarters, in Scandinavia often having a third basecamp in the calving area. That spring and autumn camp later developed into the main residence, being more centrally located in the elongated circulation pattern. Herding has, during this century, turned into a more extensive form, and there are several reasons for that. The gradual elimination of predators, like wolves and wolverines, by means of modern firearms made the concentration of animals for protection less crucial, while milking was less important now that other foods could be bought instead. More milk to calves in turn meant better rates of survival and herd growth. The more extensive herding also made it less necessary for the women to come along into the summer fells to do the milking. So they and the children and aged stayed behind at the spring-autumn station, which had generally developed into the hub around which the pastoral activity system revolved.

Today the Swedish Saami have settled into the small centers of interior northern Sweden such as Jokkmkokk, Arjeplog, and Arvidsjaur. The active herders follow the herds and lodge with the sedentary, non-Saami, population during the winter, and in cottages or tents during the summer.

Reindeer husbandry, and herding, has thus changed character as a result of the growing interaction with the outside world, and nowadays the former Mountain Saami practice a kind of transhumance covering only part of the population. Their ecotechnology has also been modified and mixed up with industrial components such as field radios, modern fences and various new means of transport, such as motorboats and snowmobiles.

The capability constraints have changed during these centuries of changing herding practices. The individual capability, the biological make-up in Man, has not changed, But the coupling constraints, the need to be at certain places at certain times, have been affected greatly by the new ecotechnology. Telephones, radios, and all the new means of transportation have greatly expanded the "prism habitat," both is size and shape. The socio-ecological system of the Saami, built up during centuries of nomadic life, is under hard pressure within the modern Swedish and Fennoscandian society. The Saami are trying to retain to the traditional, indigenous, form of land use, but they find it more and more difficult to defend their right to the land - a type of land claims issue.

And what will happen if the new ecotechnology breaks down, e.g. because of rapidly rising fuel prices? The cheap, new energy introduced into the system by the automobile, the snowmobile and, partly, the helicopter, is now the Achilles heel for the whole herding system, and thereby for the Saami culture.

For the Inuit of the New World, the change has been in most areas similarly dramatic, but that is another story.

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Modern Communications Technology: Safeguarding Inuit Cultural Heritage

Marianne Stenbaek

In this symposium, we have focussed mainly on the physical aspects of heritage such as lands, parks, etc. and the preservation and conservation of this heritage. But there is an equally important heritage-- a cultural heritage and a symbolic heritage which it is an imperative to safeguard.

What then, are the means with which to preserve this heritage and what are some of the things that can be preserved so as to constitute a cultural heritage for future generations?

It is my contention and experience that modern electronic communications technologies are some of the very best ways to maintain the Inuit cultural heritage and also help them manage their physical environmental heritage.

Nowhere in the world is communication more difficult than in the Arctic, with its enormous distances, its sparse population and its often fierce weather. Nowhere is communication maybe more necessary for the survival of its cultural heritage and for the management of its physical heritage.

Modern communications technologies alone can overcome the obstacles of distance and weather; they are eminently suited to the Inuit because the new technologies offers them a twentieth century version of their traditional communication patterns.

We, in the non-Inuit western world, have saved our cultural heritage in many ways, mainly through the printed word, through books. But the Inuit have never had this opportunity, for they have gone directly from a pre-literary, or oral/aural mode of life (the so-called "village era") to the electronic world. The oral/aural mode and the electronic mode are very much alike, in that they rely on sight and sound and invite direct participation. This is why the electronic media are so eminently suitable not only to conserve the Inuit cultural heritage, but also to revitalize it and make it flourish.

McLuhan, in somewhat of an over-generalized, but still valid, paradigm, divided the cultural/communicational history of man into three eras. First there was the village era–an oral/aural period of culture where the modes of communication, by which I understand the means of transmitting, preserving and expanding culture, were mainly verbal and were limited in time and space to the present. The modes of communication in this era were stories, legends, music, songs, dance,–good modes because they involve people *directly*. You cannot close your ears–sound is a 360°

medium–and storytelling implies that you have an audience, it is personal and interactive. The dances and storytelling gestures are visual. All these modes include the community in one way or another. These modes also depend on, as well as foster, close physical proximity such as it existed inside the Igloo or in summer camp because you cannot tell a story to someone unless the audience is within certain physical distance i.e. the range of your voice.

These communication patterns can be seen to reflect the whole way of life of the Inuit, because their very survival depended on the use of sound and sight (e.g. in hunting) and on maintaining a close community in which everyone participates. The oral/aural era of communication describes the Inuit's culture well, for this is how their cultural heritage was preserved until a few decades ago. It was a visual and participatory mode of communication, but because of its limitations of time and space, it could only preserve cultural heritage in memories and legends passed on from generation to generation. It was a haphazard preservation and one that is becoming increasingly haphazard as modern times encompass the North.

In the Western world, a very different historical/cultural era followed this early era–namely the Gutenberg era–where western man got the printing press. With it, western man became alienated from "the village" (the close community), for reading and writing are private functions; the notion of privacy was invented. The printing press became the guardian of our cultural heritage. Books, however, do have the advantage of being able to overcome time and space. The Inuit never experience this "Gutenberg" period. They continued throughout this historical era in their oral/aural mode, the "village era."

In this century, the Western world had the electronic communication revolution which gave us the electronic media: radio, telephone, television, teletext, videotex, film, computers and satellites. They have all the characteristics of the communication media in the first oral/aural "village" era: the immediacy, the participation, the emphasis on sight and sound. Except, the electronic media have two superbly important attributes added, namely that they have conquered time and space thus it was again possible to have communication which was direct, live and instantaneous, just like in the first "village era" but now with the important difference that they are also able to preserve the communication for many, many years. The electronic media made it possible, once again, for people to become participants, but now on a much larger scale, a global scale.

The "Global Village," as McLuhan called it, was born and it is perfect for the Inuit, for they have never, in a sense, left that village. They have never been caught up in the Gutenberg era, so for the Inuit, the electronic age is a direct extension of their age-old cultural and communicational patterns, where the emphasis is still on the oral/aural modes, sight/

sound– and on participation. In effect, because of the technical possibilities of these new communication technologies, they have made it possible to expand the traditional pattern of Inuit village life right across the Arctic, creating what one might, with a McLuhanesque phrase call a "Global Igloo."

The new electronic media, while retaining all the old attributes also added the two important attributes, the ability to conquer and preserve time and to conquer and preserve space. These are immensely important to the Inuit and to the preservation of their cultural heritage.

Now an event can be seen and heard simultaneously/instantaneously anywhere in the world: in Akiak on the Alaskan tundra; in Eskimo Point, Keewatin; in Nuuk, Greenland and a thousand other places–and– *and this is the overwhelmingly important point–* the event can be preserved, it can be seen/heard now *and* in a year *and* in one hundred years.

All of this is to make a very simple point, that because the electronic media/environment/technologies are so much a direct and natural extension of an already existing cultural and communicational pattern for the Inuit, much more so than for the non-Inuit, they are a *natural* and superb way, not only for safe-guarding their cultural heritage but also for reaffirming and revitalizing it. The modern communication technologies can easily reach right across the Arctic, involve many Inuit groups and spread Inuit culture, thus giving new life to the old traditional ties across the Arctic.

The Inuit have been quick to learn and are already, maybe more than any other cultural minority, using modern communication technologies to both preserve and revitalize their culture. A few examples will serve to illustrate this new reality.

The Inuit Circumpolar Conference, whose aim is to re-unite Inuit across the Arctic and to collectively ensure the survival of the Inuit culture and way-of-life, has been very quick to recognize the value of modern communications technologies in their efforts and through its Communications Commission has carried out a series of important experiments with long-term implications. The best delivery system in the Arctic is a satellite system because it conquers distance and weather. So for the ICC General Assembly in Iqaluit (Frobisher Bay) in 1983, the Communications Commission bought a TV-receive earth station which was installed in Nuuk by Greenland Telecom (the official communications agency). In this way it was possible for the Inuit Broadcasting Corporation (the Canadian corporation set up by Inuit to deliver Inuit-made television in Inuktitut across the Canadian North) to transmit live and direct coverage of the ICC General Assembly, not only to the Canadian North and Alaska, but also to Greenland. The Inuit Broadcasting Corporation used its alloted space on the CBC channel on the Canadian domestic satellite, Anik.

It was the first direct Inuit television broadcast right across the Arctic and was met with much enthusiasm by its audience. The experiment proved that there are no technical problems (none was expected) in such transmission. There are, however, legal problems in that the Intelsat agreement (the agreement which governs the use of most transoceanic and international satellites) prohibits the use of domestic satellite for international use such as between Canada and Greenland. In Alaska, a private company MultiVision has already been granted legal use of some programming carried on the Anik satellite. The ICC Communications Commission believes so strongly in the cultural value of such broadcasts that it is actively seeking an exemption from the Intelsat agreement because one of its main priorities is to establish an ongoing program exchange among these three countries by satellite. Such an exchange is already carried out on a very informal basis by means of taped programs but is in the process of being formalized.

A smaller but equally successful experiment was carried out between the Inuit Broadcasting Corporation and Kalaallit Nunaata Radioa (Greenland Radio and Television) in November 1985. A television talk show on the topic of communication originated from the IBC studios in Iqaluit and was transmitted live via the CBC channel on Anik to Greenland where it was screened directly for the participants in a media conference arranged by Home Rule Government. The participants were able to ask questions via telephone of the Canadian Inuit in the Canadian studio. The Greenlandic Inuit could both see and hear the Canadian Inuit, whereas the Canadians could only hear the Greenlanders. All spoke in their own Inuit dialect.

The experiment was successful in two important ways. It showed that technically it is quite possible to have a live interactive talk show between the two countries and maybe even more importantly it showed that Inuit from different countries could talk in their own dialects and still be understood by each other. The fact that the modern technologies allow the Inuit to experience each other's dialect directly (either as in this talk show or through the exchange of taped programs) revitalizes and keeps alive the Inuit language as well as promotes greater understanding among the Inuit in many different ways.

For the 1983 ICC General Assembly, the Canadian Department of Communications mounted a Telidon (the Canadian-made version of a videotex system) experiment as part of the UN international communications year. It linked sites in Barrow; Anchorage, Alaska; Washington, DC; Kuudjuaq, Iqaluit, Canada; Nuuk, Greenland; Copenhagen, Denmark. A data base was created for it by the author. The base contains information on Inuit organizations in the three countries, on ICC, and on Iqaluit. The National Museum of Man provided a database showing the historical evolution and migrations of the Inuit. A microchip was developed which allowed the Telidon terminals to write in syllabics, the Canadian Inuit writing system which is based on signs.

Another example is the Learn/Alaska system, operated by the University of Alaska, providing television as well as audio and video conferencing to every bush village in Alaska with more than 25 people. Each such village has a satellite receiving dish, there are now dishes in 257 villages. The Learn/Alaska network broadcasts educational programs as well as programs about the various indigenous cultures, such as the Inupiaq and Yupik.

A major benefit of the Learn/Alaska system is its capacity to allow people to hold meetings across the state by audio and video conferencing. This has an enormous importance in the North where a lot of people tend to feel very isolated, and where the demands of the modern age result in many, many meetings. The audio and video conference system saves travelling time; it has psychological benefits in that people can stay home in their villages and not have to travel for days; it also has great financial benefits, which is important as travelling in the Arctic is extremely expensive.

The ICC Communications Commission has used the Learn/Alaska audio and video conferencing network to hold meetings that included people from sites in Greenland, Denmark, Canada, Alaska, and other states. To get the 8-10 people involved in such a meeting together in one place would cost close to $30,000 in travelling expenses and up to 4-5 days of travel time, but an audio conference can be held for approximately $1000, and people can quickly return to their ordinary work.

Another interesting feature of the Learn/Alaska system is its ability to download Apple computer programs by using the vertical blanking interval (VBI). It uses the 21 left-over lines on an ordinary television screen to carry textual information. The system is called teletext. All elementary schools in Alaska have been equipped with Apple computers and many are able to use the VBI to download new software in this way.

I remember travelling to a Yupik village, Akiak, out on the Alaskan tundra, where people still live in houses built on stilts in the delta of the Kuskokwim Yukon rivers. But inside each home one found a colour television, video games and sometimes a computer. All are used ardently by the children. For example, the school children in Akiak have used the Learn/Alaska audio conferencing system to audio conference with some of the space shuttle's astronauts.

Another interesting use of modern communication technology in the Arctic is the North Slope Borough's Geophysical Information System (NSBGIS). It is a computer-based system that stores all data from the North Slope pertaining to the land, its animals and its plant life. The system is able to draw any map needed with any configuration of geological, biological, and zoological factors. It is an enormous database that helps the Inupiaq in the North Slope Borough deal with such things as oil exploration, leaks in the oil pipeline, and the commercial development of land. The North Slope Borough expects the system to be able to pay for itself with the income from sales of its print-outs.

The NSBGIS system also has an electronic mail system which has been used by the NSB and the ICC, for instant communication across the Arctic. The electronic mail system has proven extremely useful, as phone calls or other types of contact often can be difficult and expensive. However, the computer lines seem to go through very well and the cost is minimal.

These are some of the imaginative uses of modern communications technologies in Inuit communities. The technologies are, of course, also used in more traditional ways as preservers of culture in that television, film, and radio can record the actual non-material artifacts of culture, such as the Elders dancing, the making of crafts (e.g. how to make skin mittens), hunting skills, etc. and of course the language itself.

Cultural heritage is more than facts and data–it is also a way of looking at the world. Let's use the example of land. We are all often busy preserving the land itself, but what about the Inuit's perception of land, its symbolic value. It is equally important to preserve that–and television/video/film can do that.

The Inuit have a very different way of looking at the land. They look slowly, very slowly, very carefully picking out details which the non-Inuit often miss. There is a lack of distinction in the Inuit's mind between what a non-Inuit calls "land" and "ice." To the Inuit, both "land" and "ice" are "land" i.e. places to go hunting, to go travelling, to set up camp. As Mark R. Gordon, president of Makivik Corporation said recently in the dispute about the use of the water which the Polar Sea sailed through: "We walk on that water, eleven months a year."

The Inuit Broadcasting Corporation has done a great job in preserving this more intangible side of culture. Their programs which use Inuit scriptwriters, camera persons, sound persons and editors show this difference in perception quite clearly. There really is an Inuit way of perceiving land and environment; it is important to preserve that too.

The physical/environmental heritage can be conserved through land use planning, environmental strategies, etc. and its symbolic heritage through video, television and film. Both forms of conservation are equally important for one kind of heritage lends credibility and stability to the other. Indeed, in environmental cases Inuit stories, legends, and films– the symbolic evidence of land use–have been offered as evidence of the Inuit's rights to the land.

The use of modern communications technologies have come easily to the Inuit because the technologies reproduce old communications patterns, though it is now on a circumpolar scale. The new technologies are indeed creating a "Circumpolar Igloo."

Communication is the basis of information and therefore also at the root of decision-making and management. There is a very clear and close correlation between communication abilities and economic/political power. Inuit organizations have been quick to realize this; their experience and their concentrated efforts to cooperate across the Arctic in the use of new technologies can be powerful tools for the Inuit to preserve their cultural heritage and to present their point-of-view, thereby gaining both economic and political power.

The modern communications technologies both safeguard their symbolic/cultural heritage and at the same time make it possible for the Inuit to participate more fully and quickly in the decision making process about their physical environmental heritage.

The modern communications technologies are thus of fundamental importance to the Inuit in preserving and revitalizing all aspects of their, and our, Arctic heritage.

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Land Claims, National Parks, Protected Areas and Renewable Resource Economy

The Tungavik Federation of Nunavut

Introduction

There are two Inuit land claims in the Canadian Arctic. The Inuvialuit claim in the Beaufort Sea region, which was settled last year (DIAND, 1984) by the Committee for Original Peoples Entitlement (COPE) and the Nunavut Land Claims Project currently being negotiated by the Tungavik Federation of Nunavut (TFN). Remarks on this topic will be confined to the Nunavut Land Claims Project.

In this paper the term Nunavut Territory or Region, is used to refer to the area of claim in which Inuit of the Nunavut Land Claims Project are negotiating aboriginal rights. In the political context the term Nunavut Territory refers to the new territory that will be carved out of the existing Northwest Territories at the time of division. It may or may not include the Beaufort Sea region.

The TFN, a federation of Unuit organizations and regional councils, represent some 15,000 Inuit of the Nunavut Territory. This territory encompasses most of the lands and waters east of the Beaufort Sea, and north of the treeline, extending into the High Arctic Islands. It includes the Kitikmeot, Keewatin and Baffin regions and covers approximately 2.849 million square kilometres. This region represents the area of contemporary Inuit use and occupancy. The archaeological record however. indicates a much more extensive use of the Arctic, extending well in the High Arctic Islands and south into the Province of Manitoba (Freeman, 1976).

The Inuit claim is based on their long time use and occupancy of the Arctic and the fact that they have not ceded or surrendered their rights or title to the lands, waters and resources through treaty, war or peaceful conquest. The thrust of the current federal claims policy (DIAND, 1981) (now under review) is the negotiation of claims with aboriginal peoples in order to clear title to the land, so that governments and developers may use the land with legal certainty. This requires estinguishment of the aboriginal title. In exchange, Inuit are to be given some lands, some cash compensation for lands given up, and certain rights regarding resource use and management.

Renewable Resource Economy

The Inuit of this region are hunters, fishermen and trappers - making their living from the wildlife resources of the land and the sea. In the past, Inuit lived on the land and hunted and travelled freely, limited only in their activities by technology, the availability of wildlife, and their own sense of conservation. The availability and abundance of wildlife was controlled by climate, environmental factors, migratory behaviour, and food supplies and required Inuit to be flexible in their patterns of resource use. A scarcity of game in one area meant travel to other areas, or its seasonal availability meant food supply limited to certain species at particular times of the year. Thus Inuit had to be monadic and adaptive in their patterns of resource use. They followed the game, taking what was available, when it was available.

Little has changed today. Inuit are still heavily dependent upon wildlife and still hunt, trap and fish for a living. But rather than being based on the land year round, most Inuit now live in communities from which they base their harvesting activities. And, instead of using kayaks, dog teams and other traditional technologies, most Inuit have now adopted modern technologies to aid them in the pursuit of resources (snowmobiles, outboard motors and boats, and rifles and shotguns, etc.)

Reliance on new technologies, however is expensive. The purchase costs of outfitting oneself for year-round hunting and fishing (if one were to start from scratch) would run close to $10,000. Snowmobiles run from $2000 to $5000; outboard engines and boats $3000 and up; and arctic sleeping bags, the different rifles and shotguns required by law for different types of game, and adequate outdoor clothing for the different seasons would cost another $200. Snowmobiles depending upon the ice and snow conditions and the loads they are pulling get in the vicinity of 5 to 10 miles to the gallon. Gasoline prices vary, depending on the location, but in general, cost in the vicinity of $2.50 or more per gallon. And these purchases, it must remembered are not once-in-a-lifetime buys, but must be replaced every few years or so because of constant usage. In addition to the initial capital outlay, hunters must pay for the operation and maintenance of the equipment, which depending on frequency of use, can run as high as several thousand dollars annually. Snowmobile trips of hundreds, or even a thousand miles can cost a hunter hundreds of dollars for gas alone. To this must be added the cost of repairs, ammunition, and the purchase of other supplies. Even after the initial investment in equipment and the outlay of capital for a hunting trip, hunters are not guaranteed a return. Bad weather, a scarcity of game, or equipment failure or loss, can result in a zero or even negative return on the hunt. Inuit, therefore, must be able to use the lands and resources freely in a manner that allows them to meet their economic needs. They cannot and should not be restricted in their use or areas or resources, nor their methods of capture. Nor should they be limited in the purposes of their hunt.

Inuit cannot simply hunt for subsistence purposes without a means of acquiring cash to support their activities. They must be able to engage in cash-making activities associated with wildlife use, such as commercial and sport wildlife operations and to find and develop new markets for old products. Without a wildlife management system that permits this or with a system of Parks and Protected Areas that removes lands and resources from wildlife cash-making opportunities. Inuit economic opportunities will be severely curtailed. Viewed within the larger economy context, this is of particular concern because there are few other means by which to make a living.

Economic Alternatives

If Inuit are restricted in their use of wildlife to the point that their needs are not being adequately met, what other economic opportunities do they have? Non-renewable resource development does provide some opportunities for employment and business, but a quick survey of development activity would reveal only three producing mines (two of which will be out of production by the end of this decade) employing a total of 550 people (Polaris Mine, Little Cornwallis Island, 245 employees; Gullaton Lake Mines, Keewatin District, 125 employees; and Nanisivik Mine, Baffin Island, 185 employees) most of them non-Inuit. With the exception of the Panarctic's High Arctic Islands oil development, which will produce only one shipload of oil a year (a fraction of what is taken into the Arctic annually) and with the exclusion of Beaufort Sea development, which is outside the area of the claim, oil and gas activity is limited to a handful of exploration plays in which employment opportunities are limited and are seasonal in nature. Certainly Nunavut is well-endowed with other minerals and hydrocarbons, but soft markets and high development cost make their development in the forseeable future (15 years) unlikely. And even if a commercially viable discovery were to be made tomorrow, development lead times would place production five to ten years down the road. Thus Inuit, in the short term, cannot rely on non-renewable resources development for employment.

There are also employment opportunities available in the public sector at the community, regional, territorial and federal levels, but positions with the territorial government amount to only 500 jobs (approximately).

and perhaps a little more than that again with the federal government. There are 1,068 territorial government employees in the regional districts of the NWT. Based on population, about half would be located in the Nunavut region.[1] There are 2,600 federal employees in the NWT. No breakdown is given, but it is assumed that at least half are located in Yellowknife, the Territorial capital, the balance would be located in the regions. On a per capita basis, then, approximately one-quarter (approximately 650) would be located in the Nunavut region.[2] Other employment opportunities can be found in association with small businesses within the communities, but unless there is a strong economy to support the businesses (and there is not), they cannot flourish. And finally, there is some employment associated with tourism, but tourism is limited to a privileged group that can afford the high costs of going north. Thus employment opportunities are limited. Nearly two-thirds of territorial population is potentially in the labour force. The Inuit population in Nunavut is approximately 15,000.[3] With a potential labour force of 10,000 Inuit men and women (in direct competition for jobs with better skilled non Inuit), the northern economy as it stands today is, incapable of meeting people's employment needs. Thus the continued importance of the renewable resource economy.

Resource Management and Environmental Protection

It is, then, of considerable concern to Inuit that a sound system of resource management be in place to ensure appropriate environmental protection is provided to guarantee a healthy renewable resource base. At present, wildlife and environmental management and regulation is the exclusive responsibility of the federal and territorial governments. Inuit are not involved, except in an advisory capacity. And because they are the primary resource users and their economic well being is dependent upon a rational system of management, they are anxious for an effective role in this management and the decisions that are made.

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[1] Source: Constitutional Development in the Northwest Territories. Report of the Special Representative. January 1982:74).

[2] Source: Canada's North: The Reference Manual (1983) Section 32 Population Characteristics

[3] Source: Canada's North: The Reference Manual. (1983) Section 3.2. Population Characteristics.

Parks, Protected Areas and Conservation Areas

National parks, migratory bird sanctuaries, international biological program ecological sites, game sanctuaries and other types of protected areas are often thought of as useful management systems in the protection and conservation of wildlife and its habitat. Criteria for their establishment often require the withdrawal of the lands from general usage and limitations placed on the range of permissible activities. Thus their establishment is seen as useful in achieving general objectives of conservation.

Inuit, however, do not share the same perspective, and it is often with great suspicion and reluctance that they accept their establishment. Inuit see protected areas as impediments to hunting. Their presence may restrict access to lands Inuit have traditionally used, limit the resources they may be able to take, impose restrictions on the methods and technologies employed to hunt, and limit the purpose of their hunting to subsistence activities, thereby removing perhaps much needed commercial and sport opportunities. Inuit, of course, are opposed to such restrictions. They need wildlife to live, and view wildlife in economic terms. Thus southern notions of conservation may be inappropriate for the Arctic. The view that protected areas should offer protection from general hunting usage, that commercial and sport hunting opportunities should not be permitted, is harmful to the Inuit economy.

Conservation objectives should not be oriented solely towards ensuring wildlife is available for tourists to observe, or for scientific and research purposes or other southern needs, but should be focussed on the economic needs of the people of the region. Inuit are hunters and need wildlife to survive. Wildlife are resources, and should be seen as such. Just as southerners are dependent upon adequate stocks of cattle, pigs, sheep and poultry for food needs and economic opportunities, so are Unuit dependent upon non-domestic stocks. Inuit must be able to hunt freely and use areas and resources in any fashion that their needs require. This is not to say the Inuit should be able to hunt to the detriment of the resource base - they should not. But they should be able to hunt to meet their needs, and they must be able to use the resources in new and innovative fashions (such as sport and commercial operations) and employ modern technologies and equipment in their pursuit of same. Many of these forms of activity and the use of new technologies are not permitted in parks and other types of protected areas.

As well as being impediments to resource use, parks and protected areas are not the most effective means of protecting wildlife. Certainly they may be useful in protecting wildlife in certain locations, or at certain times of their life cycles, but as an overall form of protection their usefulness is limited. Wildlife does not respect man's administrative boundaries. Climate, food supply and migratory behaviour determines its territory and its location at particular times of the year. Changes in any of these factors may cause abandonment of protected areas, limiting the effectiveness of their establishment. Likewise, their usefulness as buffer zones as protection against development impacts is questionable. Development impacts are not limited to the development site itself, but can spill into protected areas. This is particularly true in marine areas where oil spills can easily transgrass imaginary administrative lines. Thus their value in achieving conservation objectives may be limited, and their establishment may be a greater hinderance than benefit to hunters.

Aboriginal Claims Agreements and Resource Management

TFN at the negotiating table has tried to overcome many potential problems by negotiating resource use management regimes that are more appropriately tailored for the North and the Inuit economy. The underlying objectives of these agreements are sound wildlife management, environmental protection and a meaningful role for Inuit in the management and decision making process.

Wildlife Management

The Wildlife Agreement-in-Principle negotiated in 1981, when implemented will provide the basis by which all wildlife in Nanavut will be managed. The agreement provides for the creation of a Nunavut Wildlife Management Board. It is a decision-making body composed of equal numbers of Inuit and government. Its responsibilities include, amongst other matters: the regulation of harvesting methods and practices; the allocation of quotas; the approval of commercial and sport hunting operations; habitat classification and protection; wildlife research; and the establishment and operation of sanctuaries and conservation areas. Its mixed composition of Inuit and government managers provides for the involvement of the primary resource users in its management and allows for an integrated and comprehensive approach to management, rather than a species-by-species approach. Its decisions regarding the use and management of wildlife are to be made subject to principles of conservation. These principles which are subject to future discussions with government must reflect the economic importance of wildlife and the realities of northern living.

Under the Agreement, Inuit have rights to all flora and fauna and have the rights to hunt, trap and fish anywhere in Nunavut, including national parks and other types of protected areas. Specific hunting regimes for protected areas are to be negotiated bilaterally between Inuit and government officials. In the event of any inconsistency with the wildlife agreement the provisions of the wildlife agreement will prevail. Inuit needs - if quotas are required - are to be met first. As well Inuit are to get first crack at commercial and sport opportunities and at the establishment of naturalist lodges. And because of the importance of wildlife to the Inuit economy and the costs associated with harvesting the final agreement will provide for the establishment of hunter support programs and other forms of economic aid required for renewable resource development.

But the wildlife agreement provides only part of the overall management picture. To ensure wildlife is around for people to hunt, its habitat must be protected from the impacts of development.

Land and Resource Management

To this end, TFN has tabled a Land and Resources (Land and Resource Provisions of an Agreement-in-principle August 1982) document aimed at providing a systematic and rational approach to development and the decision-making process. It is a comprehensive package in that it provides a management system to deal with all aspects of development and resource use. It also includes separate provisions to deal with the unique objectives of national parks, conservation areas (which include all other forms of protected areas) and territorial parks. Nine such agreements of the package have direct or indirect implications for parks and protected areas.

The lynchpins of the "the package's" environmental and resource management regime are land use planning and impact review. Taken together, with the other elements, or subagreements of the package, they make up the management system.

The rational management of lands, waters and other resources requires the development of forward looking plans. The Land Use Planning Agreement provides the framework for this. The Agreement spells out the roles and responsibilities of various Inuit organizations and governments in the land use planning process. It provides for the establishment of a Nunavut Planning Policy Advisory Committee composed of senior federal and territorial officials, and Inuit representatives. Its function is to identify planning goals, objectives and priorities; and identify the planning regions. A Nunavut Land Use Planning Commission with representation from the federal and territorial governments, Inuit organizations and residents of the planning region is to be established. The Commission is to consult with the residents of the region, develop land use plans, and monitor development. Approval of the plans is required by both federal and territorial governments.

This agreement provides a number of changes in the status quo. In the first place, it recognizes that the primary purpose of land use planning is to protect and promote the existing and future well being of the permanent residents and communities of Nunavut, taking into account the interest of all Canadians, rather than the reverse, which has been the thrust of most federal policies. Second, it establishes a land use planning process that applies not only to the land, but the sea as well. Third, it recognizes the role of Inuit and residents in the process. Fourth, approval of the plans requires the consent of both the federal and Nunavut government rather than just the federal government. And fifth, the land use planning process will be a legislated process by virtue of the fact that it will be established under land claims legislation.

The land use plans that are developed are to be used as yardsticks by which to measure the appropriateness of development proposals. National parks and protected areas are included in the process of evaluation. If found in conformity with land use plans, the proposals are referred to a process of impact review.

The Impact Review Process as tabled (it is currently being negotiated) entails a public review of project proposals by the Nunavut Impact Review Board. The Board is composed of equal numbers of Inuit and government appointees. The proponent is required to prepare an impact statement describing the ecosystematic and socio-economic consequences and benefits of the project. If, upon completion of the review the project is found acceptable, it is given approval subject to whatever terms and conditions the Board deems appropriate. Proposals dealing with water use are handled in a similar fashion, If found in conformity with the plans for the region, the proposals are reviewed by a Nunavut Water Board, or if the proposal entails a land-based component, it is reviewed jointly by both the Nunavut Water Board and the Nunavut Impact Review Board. And as a term or condition of project approval, the proponent must negotiate an Inuit Impact and Benefit Agreement (IIBA) with the appropriate Inuit body. These agreements are to provide Inuit with employment and training opportunities, and are to include other matters that may be of consequence to Inuit (e.g., language, housing, employment rotation schedules, etc.). All proposals, whether they deal with mining, oil and gas, hydro, parks or protected areas are subject to this process.

Land Claims Agreements and Protected Areas

As mentioned earlier, TFN has negotiated specific agreements dealing with national parks, (National Parks Provisions of an Agreement-in-Principle 27 July 1983), conservation areas (Conservation Areas Provisions of an Agreement-in-Principle, 26 August 1983), and territorial parks (Territorial Parks Provisions of an Agreement-in-Principle, 21 September 1983). These agreements are designed to deal with the unique nature and objectives of their establishment and operation. The agreements recognize the place of parks and protected areas in Nunavut and provide for their establishment through a process of negotiation and consultation with Inuit and other residents. The uniqueness of each region, its residents' resource requirements, and the differing objectives of the different types of protected areas, require that they be handled on a case by case basis. The purpose of this is to ensure they are established and operated on a basis that reflects the needs of the people of the region. As a general principle under the Agreements, Inuit are to be involved in the designation of the areas, their planning, their management, and the establishment of the boundaries. They are to be the beneficiaries of training and employment programs and opportunities, and the recipients of any economic benefits resulting from their operation. Inuit as a general right are also guaranteed access to these areas and have the right to hunt, trap, fish and camp. Agencies wishing to establish protected areas must also negotiate Inuit Impact and Benefit Agreements (IIBA) with the Inuit. These agreements will spell out the specific roles of Inuit in the design and management plans, the operation of the areas, the management regime for wildlife, as well as other matters of local concern. These agreements must be renegotiated every seven years to ensure that they keep in step with the times.

The IIBAs are important aspects of protected area management because they are intended to aid Inuit in overcoming problems that may result from the inappropriate application of parks policy or the development of management plans for other protected areas that may limit access to wildlife, or the use of the area.

For instance, under the National Parks Policy (Parks Canada, 1979) prohibitions are placed on the construction of buildings and use of motorized transport in certain zones of the parks. As important as these prohibitions might appear from an environmental point of view, their application might unduly impede Inuit use of these areas because of technologies they employ (such as snowmobiles and boats) in their pursuit of resources, or disrupt their camping needs because of the prohibitions placed on the construction of outpost camp structures. Similarily the application of seasonal or zonal restrictions on hunting to protect wildlife resources in parks would inappropriately limit Inuit in their economic endeavours, or the premissive zoning of areas for use by tourists might interfere with Inuit hunting activities. Likewise the prohibitions placed on sport hunting or commercial use of wildlife in parks could limit important economic opportunities associated with its use.

Other examples of inappropriate regulation in protected areas include general prohibitions (Canada, 1977) on hunting and fishing and the use of motorized transport in national wildlife areas or the use of certain types of protected areas for recreational purposes. Also, restrictions on traditional spring bird hunting and egging, and removal of hunting areas through the creation of migratory bird sanctuaries. Spring bird hunting and egging is an important source of food when other sources of food may not be plentiful.

The agreements in general and the IIBAs in particular, it is expected, will ensure Inuit participation in the establishment and operation of protected areas and the design of appropriate policies and regulations.

Protected Marine Areas

The currently evolving concepts regarding the establishment of national marine parks and marine conservation areas is also of concern and interest to Inuit. Many proposals for marine conservation areas currently exist or are under development, for instance many of the International Biological Program Ecological Sites (Nettleship and Smith, 1975). Also Parks Canada is in the process of developing a National Marine Parks Policy (Parks Canada, 1983) and the Canadian Wildlife Service has been conducting research on polynyas (Stirling and Creator, 1981) (areas of open water in the solid ice cover) with a view to establishing a system of protection.

Inuit are in many ways a maritime people. More than half the territory of Inuit use and occupancy is located on the offshore (Freeman, 1976). All communities but one are located on the seacoast. Seals, whales. walruses, polar bears, fish and birds make up most of the wildlife resources of the Unuit economy.

Inuit carry out much of their marine activities in the nearshore regions and on the landfast ice. Floe edges, polynyas and cracks are important hunting areas. Restrictions on people's use of these areas, or inadequate forms of environment protection could result in economic hardship. Restrictions on the use of polynyas for spring hunting, the prohibition of commercial fishing or sport hunting opportunities, or the general protection of marine life in protected marine areas may unduly interfere with Inuit economic needs. Because of Inuit dependence on the marine environment a "rider" was placed on all agreements (with application to the offshore) that such topics would be open for negotiation when discussion on the offshore began. Thus provisions regarding the establishment and management of protected marine areas will likewise be topics of negotiation when Inuit begin to negotiate their rights on the offshore. Unuit are concerned that protected area establishment and operation not unduly restrict their use. It is expected that provisions on this topic will be similar to those already negotiated for parks and protected areas.

Inuit Land Ownership

The agreements negotiated for parks provide that no national parks will be established prior to the finalization of the claims. This is because Inuit, as part of the settlement package, are to receive title to certain areas of land. They will be able to select lands for a variety of reasons (The purposes of Inuit Land Title, 21 April 1983), including lands valuable for conservation purposes. If lands were permitted to be withdrawn prior to the settlement of the claim, Inuit land holding opportunities may be diminished significantly. A recent Department of Indian and Northern Affairs publication estimated that if all proposed protected area lands were withdrawn it would amount to 15 percent of the entire Yukon and Northwest Territories (DIAND, 1985). Inuit land selections may require protected area boundaries be altered, or that some lands within the designated areas be held under Inuit title. Since it is the lands and waters of Inuit use that are being negotiated, Inuit needs are to be the primary consideration in the selection process around which all others must work.

Outpost Camps

There are two other agreements of relevance to parks and protected areas - the Outpost Camp Provisions (Outpost Camp Provisions of an Agreement-in-principle, 20 May 1983) and the Archaeological Provisions (Archaeological Provisions of an Agreement-in-Principle, 20 October 1983). The outpost camp agreement provides Inuit with the right to establish outpost camps anywhere in Nunavit, including national parks and protected areas. Outpost camps are required in the pursuit of wildlife. They serve as the base camps from which Inuit operate. Because Inuit must travel to where the wildlife is, by necessity some camps will have to be located in parks and protected areas. Inuit cannot be prohibited from establishing camps in the vicinity of wildlife simply because it has a protected area designation. Specific outpost camp needs in parks and protected areas are to be topics of bilateral negotiation under the IIBAs.

Archaeological Resources

The management of archaelogical resources in parks and protected areas will be affected by the archaelogical provisions of the agreement. The agreement applies to all archaeological resources throughout the territory. The archaeological provisions provide for the protection of archaeological resources throughout the territory. Amongst other matters, the agreement provides for an Inuit role in the development of archaelogical policies, a review of permits with veto rights in certain instances, employment and training opportunities, the maintenance of collections in Nunavut and the return of archaeological materials that have previously been removed. The protection, development and use of archaeological resources within parks and protected areas is also subject to and bilateral negotiation under IIBAs.

Conclusion

The scope of the Unuit claim in the management of resources is comprehensive. The intent of the agreements is to provide a role for Inuit in the use and management of resources in Nanavut and to ensure that management of the resources is compatible with their needs and aspirations. The conservation of wildlife and protection of the environment must take into account the realities of northern living. Inuit depend upon wildlife resources of the land and the sea, and in order to survive, must be able to continue to do so. Their continued survival and use of resources is contingent upon a satisfactory settlement of aboriginal claims.

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Tourism and Conservation: Case Studies in the Canadian North

J.S. Marsh

Introduction

This paper concerns tourism and conservation, especially in the Canadian North. Tourism and conservation are activities and land uses linked in a relationship that merits attention because it is common, seems attractive, but is problematic. We face a dilemma. If heritage conservation is justified, even partially, in terms of tourism and its economic returns, then we must be prepared for an influx of tourists to heritage areas and a degrading impact on them. If we do not justify heritage conservation, at least partially, in terms of tourism, there may not be sufficient public and political support to ensure heritage areas are designated and protected.

To investigate the relationship and the dilemma, the author is undertaking research for a comparative study of the tourism and conservation relationship in three geographically different areas: small islands in developing countries, the Canadian Rocky and Selkirk Mountains, and the North. This paper deals in an exploratory fashion with the northern component of this study. It is based on literary and field research, including that undertaken by students in recent years in Ellesmere Island, Baffin Island, Nahanni and Northern Yukon.

First, the terms "tourism," "conservation" and "North" are defined, and then some theoretical relationships between tourism and conservation, leading to symbiosis or conflict, are discussed. Next some basic facts on tourism and conservation in the Canadian North are presented. This is followed by an examination of the actual relationships in Auyuittuq, Nahanni and Kluane National Park Reserves, and by a more detailed study of the Northern Yukon, part of which has recently been declared a national park. Finally, some conclusions offering both warnings and solutions, are provided, as well as ideas for further research, including that of an international study of this issue in the Arctic.

Definitions

A variety of definitions of the terms "tourist" and "tourism" have been offered. Smith (1978) defined a tourist as a temporarily leisured person who voluntarily visits a place away from home for the purpose of experiencing a change, while MacCannell (1976) refers to tourists as "sightseers, mainly middle class, who at this moment are deployed throughout the entire world in search of experience." The International Union of Official Travel Organizations defined tourists as

> temporary visitors staying at least 24 hours in a country visited, when the purpose of the journey can be classified under one of the following headings:
> Leisure (recreation, holiday, health, study, religion, sport)
> Business, family, mission, meetings (Lundberg, 1974).

Tourism can then be defined as a system or industry catering to tourists, or in the words of The Tourism Industry Association of Canada (1985) as the business activity that fulfils the needs and wants of non-resident consumers. The Association goes on to say that the industry comprises "businesses, organizations, labour and government agencies," but often it has been described more broadly as consisting of the four "A's" attraction, accommodation, access and advertising. Tourism can be categorized, as Smith has done (1978) according to its focus and activities into ethnic, cultural, historical, environmental, and recreational types. The historical and environmental categories include the tourism discussed here which is dependent on national parks, conservation areas and heritage sites.

While conservation has been deemed "the wise use of natural resources," it is taken here to refer more specifically to nature conservation and to national parks. In Canada, national parks are intended:

> to protect for all time representative natural areas of Canadian significance... and to encourage public understanding, appreciation and enjoyment of this natural heritage so as to leave it unimpaired for future generations. (Parks Canada, 1979).

The term "North" is defined in many different ways, but is taken here to mean lands and waters north of 60° N. Furthermore, while tourism and conservation relationships and problems are evident in many northern countries, the emphasis here is on Canada, and the Yukon and North West Territories in particular.

Tourism and Conservation Relationships

The relationship between tourism and conservation in parks has been examined by Budowski (1977) who has identified three possible relationships and a common trend. First, he notes that tourism and nature conservation in parks can be in conflict. Second, there can be coexistence, though he observes that "this situation of coexistence rarely remains static, particularly as an increase of tourism is apt to induce substantial changes, so that this stage is followed either by a mutually satisfactory relationship (symbiosis); or by conflict." Third, and ideally, there is symbiosis in which both tourism and conservation benefit from being related. Budowski concludes that although examples of all these relationships "exist for the majority of cases at present the relationship between tourism and conservation is usually one of coexistence moving towards conflict, mainly because of an increase in tourism and the shrinking of natural areas."

The potential for conflict between tourism and nature conservation in a park can be examined theoretically using a matrix of park characteristics and tourism characteristics. Parks can be characterized in terms of scale, character, fragility and purpose. Accordingly, they may be small or large, natural or man-modified, fragile or resistant, intended for nature conservation or for tourism. Tourism can be characterized in terms of scale, character, facilities, and visitor patterns. Accordingly, there may be a lot of tourism or very little, it may involve a lot of technology or very little, it may require many facilities or very few, and visitors may be concentrated or dispersed.

Depending on the mix of these characteristics, the relationship between tourism and nature conservation in a park may be one of high, medium or low conflict. High conflicts can be expected when large scale tourism, involving very technological activities and numerous facilities occurs in a park that is small, natural, fragile, and intended for nature protection. Low conflicts can be expected when small scale tourism involving nature oriented activities, requiring few facilities occurs in a park that is large, natural, environmentally resistant, and intended for tourism. A variety of other relationships resulting in high and low conflicts can be postulated. However, a typical conflict occurs when large scale tourism involving some technological activities and many facilities occurs in a park of medium size, with some natural areas that are fragile, that is intended for nature protection and tourism.

Historically in Canada, tourism and nature conservation were often amalgamated. The National Parks Act of 1930 recognized this when calling for national parks to be maintained unimpaired but to be used for the benefit and enjoyment of present and future generations. This, apparently paradoxical, aim was acceptable then because in general people were not so concerned about maintaining pristine natural environments, and in any case tourism was on a small scale. However, as demands for stricter nature protection emerged, and tourism increased, conflicts developed between the two land uses and became the subject of public debate and political decisions.

The debate over tourism in parks intensified in the 1960s and 1970s when major tourism developments were proposed in the national parks, such as a large resort at Lake Louise, the Winter Olympic Games in Banff National Park, commercialization of the Nakimu Caves in Glacier National Park, and the provision of a sky tram in Gros Morne National Park. The debate revealed how individuals, interest groups, and government agencies often have widely differing perceptions of what constitutes conflict between tourism and conservation (Maychak, 1985). Marty (1984) puts it most succinctly when he says, "what one person sees as impairment, looks like wondrous improvement to another."

With respect to the national parks, Eidsvik (1983) has argued that the relationship between tourism and conservation "is symbiotic, and it is expected that it will be mutually reinforcing." Others (Dearden, 1982; Jackson, 1981; Marsh 1982) have argued that the relationship is one of conflict leading to degradation or "prostitution" of park environments. More specifically, the resort of Banff has been viewed as a gem nestled in the wilderness, as an intrusive honky-tonk town, and even as "metro Banff" (Marty, 1984).

The severity of conflicts between tourism and conservation in parks varies from one to another, according to the character of the park and the nature of tourism. In Canada, today, the national parks could be ranked on a tourism impact spectrum that would likely have Banff and Point Pelee at the high impact end, and Pukaskwa and Terra Nova at the low impact end. Most parks would be in the middle, with generally acceptable levels of tourism, few major development proposals, and little national debate over tourism in such parks.

National parks in the North would be ranked at the low impact end of the spectrum, largely because of the absence of long-established tourism facilities, and the comparatively low levels of tourism. However, as tourism increases, developments are initiated and impacts occur, some northern parks may be ranked higher on the tourism impact spectrum. Indeed, there has already been considerable debate regarding specific proposals for tourism developments in some northern parks, and about the sensitivity of northern environments to tourism impacts. Before examining these issues by reference to some case studies in Canada, however, it seems desirable to provide an overview of tourism and conservation in northern Canada.

Tourism and Conservation in the Canadian North

As tourism in the Canadian North is largely dependent on natural attractions, nature conservation and national parks, the evolution and character of conservation today will be summarized first.

Conservation

Nature conservation in the North began with the native people who generally used the environment and wildlife on which they depended in a way that limited impairment and threats to their survival. However, with the arrival of white people, new technologies, and new markets for wildlife products, nature was more intensively and extensively exploited. When the first areas of exploitation were degraded and numbers of animals were depleted, new areas were exploited until such activities became unrewarding, uneconomic, or regulated to protect the resources.

During the 1890s, for example, the arrival of tens of thousands of gold seekers in the Klondike led to a considerable local impact on the wildlife, and the subsequent passage of conservation legislation. Dominion Land Surveyor Ogilvie reported (Harris, 1897), that "game is not now as abundant as before mining began, and it is difficult, in fact impossible, to get any close to the river." Similarly, a miner noted, (Harris, 1897) with respect to moose and caribou, that "of course these have now disappeared with the advance of civilization, and fresh meat of any kind is now at a premium." The government responded to the situation not out of a concern for the wildlife itself, but out of concern for food supplies in the Klondike, and to prevent the native people becoming more dependent on the white community (McCandless, 1985). An amendment in 1900, to the Yukon Act of 1898, gave the Yukon Territory control over wildlife resources, and a year later An Ordinance for the Preservation of Game was enacted. The subsequent history of wildlife conservation in the Yukon is described in great detail in the book *Yukon Wildlife: A Social History* (McCandless, 1985).

It was gradually realized that regulating activities was not sufficient to ensure that wildlife and the environment would be conserved. In 1915, Dominion Entomologist, C. G. Hewitt observed (Commission of Conservation, 1916) that "the caribou have been totally exterminated in some localities... The musk-ox is another animal which is being exterminated in certain parts of the arctic... Protection is needed in the Northwest for the white fox, which is there becoming gradually reduced in numbers." Accordingly, beginning in 1918, game reserves were established in the North, many eventually being consolidated into the huge Arctic Islands Preserve (Hunt, 1976). In 1922, 28,700 square kilometres of boreal forest, prairies, lakes and muskeg on the Alberta-Northwest Territories border was designated Wood Buffalo National Park (Ogilvie and Scace, 1979). This national park, the first in the Canadian North, was intended to protect the remaining 1,500 wood bison, and was expanded a few years later to 45,000 square kilometres. Unfortunately, many of the reserves were soon abandoned, especially after the Northwest Territories gained control over game resources in 1948. The Arctic Islands Preserve was repealed amongst controversy in 1966.

Recognizing the potential environmental impact of the Alaska Highway, being built through the Yukon in 1942, the Canadian government, prompted by the US government, designated that same year a national park reserve in the southwest Yukon (Theberge, 1980). A year later, it became a game sanctuary, known as Kluane. In 1972, Kluane again became a national park reserve, along with Nahanni, a spectacular river corridor in the southwest corner of the Northwest Territories, and Auyuittuq on Baffin Island (Graham, 1972). While work continued in identifying further national park sites in the North, and in conducting preliminary negotiations for their establishment, it was not until 1984 that another national park, in the northern Yukon, was established. All such reserves are intended, as Parks Canada policy dictates, primarily to protect representative natural regions of the North. Yet it is clearly recognized that they will also attract tourists and in the process contribute to local economic development.

Apart from the game reserves and national parks, beginning in 1941 some federal migratory bird sanctuaries were established, and by 1983 covered some 42,775 square kilometres. In 1982, the first National Wildlife Area in the North, 2364 square kilometres around Polar Bear Pass on Bathurst Island, was designated. While some territorial parks have been established, and more are planned, as yet most of them are roadside recreation sites with limited conservation value. Territorial Land Use Regulations approved in 1971 are supposed to offer more general protection to the environment of the North but their effectiveness has been seriously questioned (O'Reilly, 1983).

In summary, there has been over the last hundred years a variety of temporary and permanent conservation initiatives in the North including regulations and land designations. These have provided some protection of the environment and a few, such as the national parks, have helped to attract tourists to the area. However, it is generally agreed that more conservation measures are needed urgently in the North, and these could further enhance the appeal of the area to tourists.

Tourism

While it is difficult to distinguish some of the later explorers from some of the earliest tourists in the North, it is safe to say that people have been visiting the North for pleasure and without being employed to do so for about one hundred years. The Klondike attracted some tourists in the 1890s and in the early years of the twentieth century other parts of the North lured a few intrepid visitors not content with the typical trip across Canada on the Canadian Pacific Railway (Hart, 1983). For example, in 1907, the artist and naturalist Ernest Thompson Seton made a 5000 kilometre canoe journey through the North. In his book about the trip entitled, ***The Arctic Prairies***, he notes that "I went for my own pleasure at my own expense, and yet I could not persuade my Hudson's Bay Company friends that I was not sent by some government, museum or society for some secret purpose" (Seton, 1911). Perhaps Agnes Deans Cameron, a retired school teacher from Chicago, who made a trip through "the new north" in 1909, made a more credible tourist. In travelling the Slave, Mackenzie and Peace rivers, she claimed to be seeking "a route unspoiled of Cook's," the travel agency then dominating world tourism (Cameron, 1912). However, she was grateful of the help afforded by the Hudson's Bay Company, which she dubbed "the Cook's Tourist Company of the North." At the same time, on the east side of the country, canoeists were descending the rivers to James Bay and affluent yachtsmen were sailing north along the Labrador coast. The missionary, Wilfrid Grenfell observed at least six yachts there in 1912, and noted that "among other ways to help Labrador we had always tried to induce tourists and yachtsmen to come and visit us" (Grenfell, 1920).

In the 1920s and 1930s, more tourists came north for big game hunting and fishing, and lodges and outfitters soon catered to their needs. Even before the Alaska highway was completed Godsell recalls "officials at Ottawa were already receiving applications for hamburger, barbecue and filling station concessions along the highway when the war is over and the tourist business gets into its stride" (Godsell, 1944). The highway provided tourists with the first road access to the North, while expanding air services opened up new areas for tourism, including the arctic islands. In the last twenty years, access and transportation to the North have been improved and expanded, it being possible to take regular buses to Whitehorse, scheduled flights to Baffin Island, and since 1979 the drive to Dempster Highway to Inuvik in the Mackenzie delta. Tourists are following such routes in greater numbers, and being attracted by new facilities and attractions including hotels, campgrounds, national parks and restored historic sites.

Comparable, reliable statistics on northern tourism are scarce but a few can be provided first for the Yukon and then for the Northwest Territories. In 1975, the Yukon attracted some 120,000 automobile visitors, but only 9.5 per cent had the Yukon as their major destination, approximately 81 per cent being Americans on their way to or from Alaska. Under 5 per cent came specifically to visit Kluane National Park, which in 1977 attracted only 4522 visitors (Wall and Bates, 1978). In 1979, it was estimated that there were about 275,000 person trips involving at least one night in the Yukon by non-residents of the territory (Thorne Stevenson and Keliog, 1982). It was noted that 74 per cent of these tourists who were travelling by automobile were passing through the Yukon, usually on their way to or from Alaska.

For 1984, it was estimated that there were 330,000 visitors to the Yukon at least two thirds of them going to and from Alaska (Lush, 1985). They spent an estimated $82 million in the Yukon, up 6 per cent from 1983, but down in terms of inflation-adjusted per capita income from tourism. Gold Rush sites proved to be a major attraction, but at least 2000 automobiles, campers and buses are now travelling the Dempster Highway, and in 1985, there were 65,000 visitors to Kluane National Park.

With respect to the Yukon, it has been stressed (Lush, 1985) that tourism is a very competitive business, that the territory is an expensive destination with a short season of 120 days at best, that there is a need to diversify the attractions and develop winter tourism, but that "wilderness travel is growing and is forecast to increase sixfold in the next 20 years."

The Northwest Territories attracted about 1000 visitors in 1960, rising to 12,500 in 1969, half of which were from the United States, and to some 20,000 in 1975, when less than a quarter were from the United States (Wall and Bates, 1978). By 1983, there were an estimated 44,000 visitors to the Northwest Territories, including 5000 coming on commercial flights, 11,000 on private flights, and 18,000 by road (NWT, 1984). Of the visitors staying at hotels, motels and lodges, 28 per cent were from Alberta, 26 per cent from the United States and 16 per cent from Ontario. They generated an estimated $65 million in revenue for the Northwest Territories. The four most popular activities reported by visitors surveyed were shopping for crafts (52 per cent), fishing (40 per cent), visiting museums and historic sites (40 per cent), and nature studies and walks (32 per cent).

The vast majority of visitors to the Northwest Territories, for example, 67 per cent of guests surveyed in hotels, motels and lodges, travel to the Fort Smith area. Approximately one third of summer visitors are reported to visit the Inuvik region, but much smaller numbers visit the Central Arctic, Baffin and Keewatin regions (NWT, 1984). In 1985, it was reported that Wood Buffalo National Park attracted some 1400 tourists, that Nahanni National Park attracted about 600, and Auyuittuq National Park "little more than a few hundred" (French, 1985).

In the 1985 *Explorers' Guide*, the Minister of Economic Development and Tourism for the Northwest Territories summarizes the tourist attractions in the territory by stating, "Canada's North offers you unparalleled opportunities to explore an unspoiled wilderness. Whether you're fishing a lake that is entirely yours, canoeing a turbulent river, watching the dogteam races at Yellowknife's Caribou Carnival, or just enjoying the pleasant warmth of a barrenlands summer, the Arctic has something for everyone." (NWT, 1985).

Having provided some information on the evolution and present character of conservation and tourism in the Canadian North, some case studies will now be presented indicating some of the beneficial as well as problematic relationships between conservation and tourism in this region.

Case Studies of Existing National Park Reserves

The first case studies will deal with the existing national park reserves of Kluane, Nahanni and Auyuittuq.

Kluane

Kluane National Park Reserve today encompasses 22,015 square kilometres of the southwest Yukon. It includes the Icefield Ranges with Canada's highest peak, 5951 metre Mt. Logan, and massive icefields and glaciers covering over half the park. The mountains are dissected by a number of valleys such as the Slims and Donjek, hence, the park has a variety of environments and habitats which support an interesting fauna including Dall sheep, goat, bears, wolves, and eagles. While the park has had some sort of protective status since the Alaska Highway was built along its northern edge in the 1940s, parts of it have long been used by man and therefore been modified, and it has been influenced by activities in the surrounding region.

Development continues adjacent to the park and has influenced the location of the park boundaries. For example, the Burwash Uplands, part of the original Game Sanctuary, were excluded from within the boundaries of the park reserve (Downie, 1981). This area was deemed important both by conservationists, because of the importance of the area for caribou, and by miners, because of its mineral potential. Accordingly, throughout the period of Kluane's Game Sanctuary status, mining interests repeatedly blocked efforts to improve protection of the area.

The tourism significance of Kluane has gradually increased and is now recognized in a regional tourism plan developed by the Yukon government. Aimed at enticing visitors to spend more time in the Yukon, the plan aims to guide the development of the area's attractions. Although emphasis will be on the attractions outside the park, principally wilderness and historic sites, any increase in regional tourism will have some impact on the park.

The current management plan for the park itself also recognizes wilderness and historic sites as principal attractions. It is noted that:

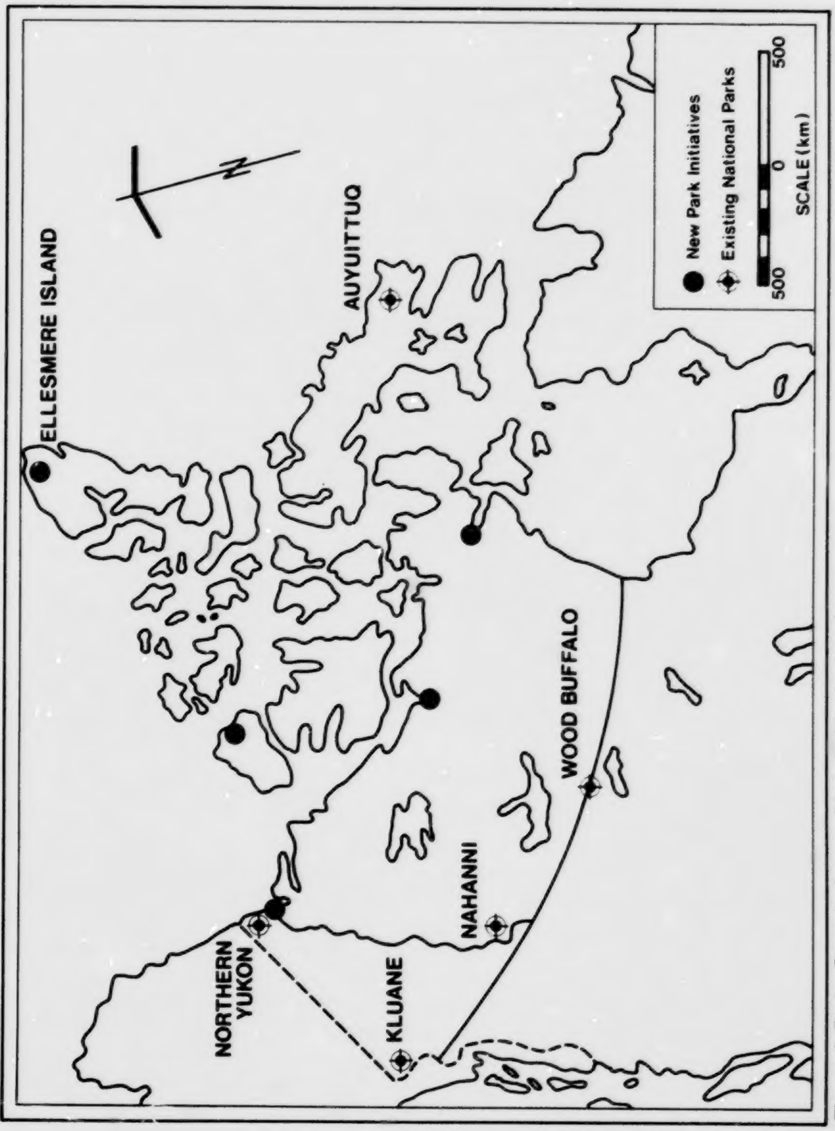

Figure 1 Parks Canada Areas of Interest in the North.

> Natural resource values are the basis on which Kluane National Park has been established and the maintenance of their integrity is Parks Canada's primary consideration. Also important to Kluane is the rich human history of the area and the resources remaining in the park that can help tell the story (Parks Canada, 1980).

In the first draft plan released to the public provisions were made for wilderness backpacking trails, horse trails, a motor boat shuttle service, a railroad to a mountain lookout, and several valley access roads. However, the ensuring public response to the plan indicated dissatisfaction with the proposals. Fifty-eight per cent of the respondents wanted no development, 19 per cent wanted limited development, while only 13 per cent approved fully of the planned developments (Anonymous, 1980).

As the result, the revised plan allows for only one motorized access route into the backcountry of the park. It anticipates a public transit system using a low grade road up the Slims River Valley to the Kaskawulsh Glacier. However, when tenders were invited for development of this transit system none materialized, presumably because such a system was not expected to be economically viable. Presently, an unsolicited proposal to run buses with big tires, up the valley for 3-4 hours, 2-3 times each day in summer, is under consideration. As this service is being proposed by a company already operating bus tours through the Yukon that could ensure a market for the service it might prove economically feasible. Before any such service could be implemented an environmental impact assessment would be made to ensure adequate protection of the park environment.

As a number of tourists in the park is increasing and Parks Canada aims to encourage this, then it will be essential to monitor impacts on the environment and the quality of the visitor experience, and if necessary introduce constraints on tourism activities in the park.

Nahanni

Nahanni is a much smaller national park reserve, comprising some 4766 square kilometres in a corridor largely along the Nahanni River in the southwest corner of the Northwest Territories. (Parks Canada, 1984) It is a forested mountain wilderness, famous largely due to its legendary history, its river scenery, and canoeing potential. Protection of this area has in the foreseeable future eliminated the possibility of damming this section of river for hydro-electric purposes and may have curtailed some mining possibilities. However, mining developments are now occurring in the vicinity of the park and possible impacts from polluted water flowing into the park and company aircraft flying over the park have already provoked public outcry and a call for environmental impact assessments, land use regulations and regional planning (National and Provincial Parks Association of Canada, 1982). The conservation function of the park and its appeal to tourists may well be threatened or impaired as resource extraction increases and spreads around the park which is by no means a self-contained hydrological or ecological unit.

In recent years, however, as management planning has been initiated and tourist use continues to increase to over 500 visitors annually, one of the main controversies has been over appropriate types and levels of tourism in the park. In particular, three questions have been raised. How many canoe groups can be tolerated environmentally and socially on the river? How many commercial outfitters should be allowed to operate in the park and how should they be selected? Should air and jet boat access to places such as Virginia Falls be permitted? (Tilden, 1984). Clearly such questions pertain not only to the conservation of the park's environment and the provision of high quality tourist experiences but to the capability of the park to produce local economic development and employment. One recent commentator on these issues cautioned that "between the "environmentalists" and the developers, you will end up with roads and resorts, but not the freedom to go anywhere once you get there." (Skrastins, 1983). It will be interesting to see, as the management plan is implemented, the public's diverse comments continue and the road access to the park improves, what balance will be struck between conservation, tourism and development.

Auyuittuq

Auyuittuq National Park Reserve was intended to protect some 21,470 square kilometres of rugged glaciated mountains and valleys on Baffin Island and, in particular, the park was expected to cater to a small number of hikers and climbers. As Lawson notes (1983) "the park concept was foreign to Inuit culture and language," it being interpreted as "the place where white men come to play." Visitation has been limited by the character of the environment and facilities and the time and cost involved in reaching it from southern Canada and abroad. However, use has increased slowly but steadily to a high of around 400 in 1983. While such a number is small compared with visitation at parks and resorts in the south, use is concentrated on the trail through Pangnirtung Pass, and visitors interviewed along this route in summer 1983 reported seeing as many as 50 other people during their hike (Fragoso and Tennent, 1983). Accordingly, the psychological carrying capacity for those seeking wilderness solitude may already have been reached.

Furthermore, in this fragile environment physical impacts from camping and hiking by even such small numbers of tourists are already becoming evident and a matter of concern. Accordingly, research has been undertaken to assess such impacts, determine carrying capacity, and guide trail, campground, and hut design and management (Churchill, 1985).

Inuit resource harvesting centers on the sea. Hence, while all traditional users retain the right to hunt, fish and trap in the reserve most exploitation occurs elsewhere. Although tourism is a recent introduction to Eastern Arctic communities and was initially viewed with apprehension, several settlements, including Pangnirtung just outside Auyuittuq, have developed community-based tourism strategies to maximize the local benefits of tourism. Visitors usually travel the 29-kilometre trip from Pangnirtung to the park entrance in Inuit freighter canoes. There are now eleven licensed outfitters in Pangnirtung providing boat service to the park and surrounding points under a shared business and standardized pricing policy.

Parks Canada has become a major employer in Pangnirtung with nine full-time and four part-time employees. Most of these positions, intentionally, are filled by local Inuit. Their lack of experience in scientific conservation techniques and activities such as mountain rescue have led to the introduction of training programs and personnel from here may later be expected to staff other northern parks. Parks Canada is also committed to a policy of buying goods and services in the north whenever possible, hence several contracts have been given out locally for regular garbage disposal and the dismantling of the Dew line site at Kivitoo. The creation of the park reserve has thus encouraged tourism and directly and indirectly contributed to economic development. What the total impact has been and what economic, social and environmental costs have been incurred remain to be fully evaluated.

Ellesmere Island

Having discussed the relationship between conservation and tourism in three existing national park reserves, I should like to focus on an area where a new national park has been proposed and controversy has arisen, namely, Ellesmere Island.

At the northern end of Ellesmere Island, the most northerly part of Canada, Parks Canada has proposed the creation of a 40,000 square kilometre national park that features an extremely cold climate, mountains, icefields, fiords and a large lake. Given the character of the environment and the difficulty of access it is essentially uninhabited although a small lodge has operated intermittently at Lake Hazen and permanent, largely Inuit communities exist further south (Johnson, 1983).

In signing a memorandum of agreement with the Northwest Territories, Parks Canada has not only taken establishment of the park a stage further but provoked concern about the ability of the park environment to withstand tourism and encouraged others to plan tourism there as a means for local economic development. Dr. John England, a geomorphologist who has studied the area, maintains that designating the area as a park will encourage more tourism than the environment can tolerate, even though he anticipates only about fifty people per year visiting such a park (England, 1983). Parks Canada anticipates that only some 22 hikers would visit the park in each of its first five years and argues that such a level of visitation would be environmentally tolerable.

Robert Trudeau, Superintendent of Economic Development and Tourism for the Baffin region predicts that the park could attract 75-100 people per year if air access and a modern hotel at Tanguary Fiord were provided and a wealthy, older clientele sought. Clearly, the Northwest Territories government, concerned about a recession in the sale of native handicrafts and sealskins, a slowing of oil and gas development and consequent high levels of unemployment, wishes to see the park serve as a means of local economic development. Furthermore, as a 1983 article in the *Globe and Mail* pointed out:

> The NWT Government has become more assertive in the past couple of years and if Ottawa doesn't cooperate on this project its other park proposals could later be in jeopardy (Anonymous, 1983).

Parks Canada and supporters of conservation in the north obviously face a dilemma. Failure to offer to manage the park so as to encourage tourism and local economic development may reduce the chance of this and other northern parks being established. On the other hand, encouraging tourism in Ellesmere Island may set a precedent that will have to be followed in negotiating for other parks and the resulting tourism may damage the environment and compromise Parks Canada's primary objective of nature conservation. Accordingly, the resolution of this issue may be important not only because of its impact on the conservation, tourism and development of Ellesmere Island but also because of the implications it will have in dealing with conservation, tourism and development relationships elsewhere in the north, and possibly even the south, where some additional national parks are still sought and provinces are bargaining for the best package of benefits.

The Northern Yukon

The final case study is of the Northern Yukon where Canada's most recent national park was established in 1984. Over the last decade, the Northern Yukon has been a focus of concern for the Canadian government, the Yukon government, the oil industry, native groups, and conservationists alike (Johnston, 1984). The conflict over the use and designation of the area incorporates many problems to be faced throughout the North.

Conservation interests have documented extensively the area's natural values (Berger, 1977; Parks Canada, 1978; Canadian Arctic Resources Committee, 1983). Various proposals have been put forth to secure the protection of the area from economic development. The recommendation of the Berger Inquiry to set aside the Northern Yukon as a wilderness park (Berger, 1977) came in response to an exhaustive investigation into the desirability of pipeline construction across the North Slope and along the Mackenzie Valley. Following Berger's submissions, the National Energy Board refused that particular pipeline proposal, which had been initiated by Canadian Arctic Gas. The Congress of the United States of America applauded this move, expanded the size of the Arctic National Wildlife Range in Alaska, and urged that the Government of Canada soon create a wilderness park in the Northern Yukon. A few months later, in July 1978, an Order-in-Council withdrew 38,000 square kilometres of the Northern Yukon for a national park and other conservation purposes. Parks Canada also released its plan and justification for a park in the region (Parks Canada, 1978). Cementing these endeavours was the October 1978 Committee for Original Peoples' Entitlement (COPE) land claim agreement-in-principle. Signed by the federal government and the Inuvialuit, this contract outlined the designation of part of the Northern Yukon as a national wilderness park as one of the basic segments of the claims agreement (Canadian Arctic Resources Committee, 1983).

These various proposals stress the value of the region in terms of its landscape and its worth to wildlife. This is the only major landscape in Canada that was not glaciated in the last Ice Age. It contains a variety of biophysical areas including the vast wetlands of Old Crow Flats, the smooth, rolling British Mountains, and the fragile North Slope itself. Within the region are various critical habitats for the Porcupine caribou herd, and for large numbers of waterfowl. Range is provided also for black, grizzly and polar bears, Dall's sheep, moose, wolves, Arctic fox and muskrat.

Also contained in the Northern Yukon are hundreds of archaeological and paleontological sites, as well as, the oldest human remains in the western hemisphere (30,000 years B.P.). There is an important historical site at Herschel Island, the location of a major Beaufort Sea whaling station at the turn of this century.

Thus, with its significance established as terrain valuable as an impressive and unique landscape, important for the survival of wildlife, and as a source of historic and pre-historic sites, the Northern Yukon presents an important challenge for those interested in protecting such values. Indeed, as Tom Kovacs, Parks Canada's Northern Parks Planner, summarizes:

> The combination of biotic and landscape features places northern Yukon in a unique position as a prospective national park. There is simply no alternative within the region... It is in this area that much of the new park planning effort will have to be focussed. Sorting out the multitude of conflicting interests in northern Yukon is proving to be a Herculean task (Kovacs, 1983).

The major opposition to such conservation efforts is the oil and gas industry in the Beaufort Seal - Mackenzie Delta region. The Northern Yukon provides opportunities for energy development, involving both exploration in the Beaufort Sea and land support systems. In the summer of 1981, Gulf Canada Resources put forth an application to build a marine support base at Stokes Point on the shore of the North Slope which thus gave rise to serious questions about the future conservation of ecologically important areas in the Northern Yukon as the energy industry expands. The base, called by Gulf "a temporary exploration facility" was to involve the construction of a deep-water port, accessible by large aircraft and winter ice-roads. The possibility was also suggested of a road inland to a potential quarry site in the British Mountains, and a link road to the existing Dempster Highway between Dawson City and Inuvik.

Such proposals not only appeared environmentally threatening but also prejudicial to ongoing native land claims. There were implications for the Inuvialuit interests in the Northern Yukon as well as those of the Mackenzie Delta Dene and the Indians of Old Crow. Protests, legal challenges and the expiry of the summer navigation and construction season prevented realization of the proposals at this time and a period of negotiation between all interest groups ensued.

Finally, the issue was resolved in 1984, with the allocation of some land to the Inuvialuit, the designation of a 10,000 square kilometres national park west of the Babbage River, and the approval of oil and resource development in various places, subject to environmental regulations.

Parks Canada with the support of the Inuvialuit and the Yukon Territorial Government, has stated it will begin work immediately to develop the new park. (Parks Canada, 1984) The park area has already attracted some tourists, for example, to make boat trips down the Firth River. Park designation will undoubtedly lure more tourists, thereby, necessitating immediate management measures to cater to them and curb any undesirable impacts on this fragile environment.

Although not yet a major industry in this region, tourism is growing. Approximately 33 per cent more tourists visited Inuvik in 1983 since the Dempster Highway opened in 1978 (Pluim, 1983). Vehicle surveys taken at the Peel River Ferry indicate that tourist traffic on the Dempster is around 2000 vehicles per summer (Peilak, 1983) or about 75-80 per cent of total summer traffic (Crombie, 1982). Not included in this estimate are those tourists who are local, drive only as far as Eagle Plains or Arctic Circle Crossing, or use the Dempster as access to a canoe or whitewater route in the Northern Yukon. Most of the travellers do drive the length of the highway to Inuvik. Once there, visitors find little to do. Enterprising air charter businesses have taken advantage of this gap by offering "flight-seeing" tours of the Delta, Tuktoyaktuk and the Beaufort. Of the three air charter businesses that offer this attraction, the more-favoured is Ram Air, since it is cheaper than its competitors, Kenn Borek Air and Aklak Air. Ram Air caters to the individual group of highway tourists interested in seeing scenery, while Borek Air has connections with Horizon Tours of Dawson, and Aklak Air receives mostly people interested in seeing oil rigs. In the summer of 1983, with word-of-mouth advertising, Ram Air ran an average close to one tour a day, with about 1000 participants over the summer (Trimble, 1983).

Other tourist operators in the Inuvik area include East Three Tours, providing boat trips along the Mackenzie, and Midnight Arctic Tours, offering van trips on the Dempster.

The other tourist centre along the highway is Eagle Plains Hotel at Kilometre 371, about the halfway point along the Dempster. The only such facility permitted in the highway corridor in the Yukon, the hotel provides accommodation for Yukon Government highway workers, as well as for tourists. Business has increased to the point where the hotel is booked fully in the park season, about 15 June to 15 August (Schmid, 1983). Patrons include Atlas Tours groups, and often people driving the Dempster to canoe the Eagle River or to reach the Arctic Circle. Atlas Tours, which ran 24 trips on the Dempster in 1983, has from 8 to 24 participants each trip (Munrow, 1983). Other tour groups, located outside the Yukon, are using the Dempster as part of their trips, but little information is available on this.

Information on the socio-economic and environmental impact of tourism in the Northern Yukon and along the Dempster Highway since its opening in 1978 is scarce. However, there is some feeling that it profits non-native northerners more than natives and that this should be rectified (Green, 1983). The author's research along the highway in 1981 revealed environmental impacts near river crossings and at campsites (Marsh, 1981). More effective management of tourism seemed called for, as well as increased public education. The highway while damaging to the environment, does present a great opportunity to explain to the public the character of northern environments, the need for their conservation, and the types of recreational behaviour appropriate there. Steps to improve tourism management and public education have now been taken, and this trend should continue as Parks Canada becomes more involved in the region. Hopefully, the Northern Yukon National Park and Dempster Highway corridor can serve as a model for the effective integration of tourism, conservation and development.

Conclusions

Conservation and tourism activities in the Canadian North both began in the last century and have become more important especially in the last twenty years. Government actions to conserve species and establish reserves and parks have often been opposed to some degree by those favouring resource extraction, and compromises on the number and extent of protected areas have been necessary. However, with the recent designation of Northern Yukon National Park, and the imminent creation of a park on Ellesmere Island, the national park system will be extended finally to the most northerly parks of the country. Tourism in the North is on a relatively small scale, concentrated in a few areas, and highly seasonal. However, it is significant to the local economy and growing in scale, with the recent voyage of a cruise ship through the Northwest Passage perhaps heralding a new era of development (Pullen, 1985).

Increasingly in the North, as in other areas, conservation and tourism have become linked, Parks have become attractions for tourists, and tourism has helped to justify park establishment. While the relationship may seem symbiotic, there have been conflicts between conservation and tourism though not to the extent experienced in the more popular parks in the south. Disagreement has focussed on the appropriate range of facilities, types of activities and levels of use in parks. Public hearings on parks have revealed a wide range of views on the desirability of parks in the North and on the character of tourism within them.

Parks Canada, despite the conflicts, has maintained a policy that seeks to combine nature conservation and tourism. Conflicts are dealt with through hearings, zoning, implicit recognition of sacrifice areas, regulation and management. Unfortunately decisions may be impeded by a lack of information on tourist use of national parks, on the expectations and experiences of users, and on the impact of tourism on the environment. Furthermore there are no detailed carrying capacity standards against which the quality of tourism in the parks, and its impacts on the environment can be measured.

Conservation, tourism and park issues in the North often differ from those in the south because native people are involved in them. Some native groups have supported park initiatives while others have opposed them. Land claims have been, and will be, a major influence on the designation of conservation lands in the North, and native peoples will be involved frequently in the management of parks. Some native people have benefitted from park tourism, but others have seen few benefits from local tourism, and are concerned about detrimental impacts on the communities.

The political advantage of combining conservation and tourism in parks in a society that still has difficulty justifying nature conservation for non-utilitarian purposes will ensure no doubt that the relationship will continue. However, as land use pressures increase in the North, and conflicts between conservation and tourism, especially in parks, continue or intensify, new methods will have to be found to resolve such issues, involve native people, and achieve conservation, tourism, and park objectives.

Research Suggestions

The above situation and the specific issues raised in the case studies indicate the need for more research on conservation and tourism relationships especially in parks in the Canadian North and lead to a number of research suggestions.

First, some theoretical research might be undertaken on the options available for satisfactorily combining conservation and tourism, and on the merits and deficiencies of pursuing conservation and tourism objectives separately. Second, more studies could be made of the evolution of conservation and tourism, and their historic relationship in the North. Third, the impact of tourism on the various environments of the North seems to merit more research. Fourth, attention might be directed at the potential role of environmental impact assessment procedures being applied to tourism developments. Fifth, surveys could be undertaken to determine public expectations regarding park environments, tourism facilities and tourism impacts.1 Sixth, research is desirable on ways to enhance the benefits of park tourism to native peoples and local communities. Seventh, studies are needed to determine the likely future demand for tourism opportunities in northern parks. Eighth, comparative research would be useful to learn about the relationship between conservation, tourism and parks in other northern countries.

Given the global scope of the conservation and tourism relationship, and the problems associated with it, an international research project, conference or publication on this topic may be timely.

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Critique of Selected Papers on Land Use and Conservation in the Arctic: Session I

J.M. Pallister

Introduction

Three papers submitted to this session and received by the author are reviewed. The papers are those authored by P.H.C. Lucas and P. Dingwall; K.V. Abrahamsson; and R. Ames (Tungavik Federation of Nunavut). The critique is provided to question certain points made in the papers, to seek clarification on specific topics, and to stimulate discussion. This critique consists of the personal observations of the reviewer.

Environmental Conservation in Antarctica and the Southern Ocean: The Role of Protected Areas by P.H.C. Lucas and P.R. Dingwall

The authors have successfully conveyed the message that the Antarctica and Southern Ocean have numerous unique features deserving protection status. It is apparent that there is presently an insufficient capability to manage the growing pressures from commercial activity, particularly tourism, renewable resource harvesting and non-renewable resource development. This critique will focus on the prospect of petroleum exploration and development activities.

There is an apparent tension with respect to two implicit perspectives of commercial development: on the one hand it is seen as threatening and undesirable, yet it is believed that commercial activities can be facilitated within constraints.

It is stated that the "great forces for conservation are being inexorably eroded by growing commercial and scientific activity, supported by increasingly sophisticated technology." Also, the authors state that "oil recovery would almost inevitably result in environmental damage, the extent of which is a matter of considerable conjecture and real concern." Reference is also made to the "exploitation" of resources.

On the latter point, in Canada a distinction is made between "exploitation" (which is undesirable) and "development" which may be permissible under certain conditions. "Exploitation" has the connotation of irresponsible extraction of resources. "Development" by contrast is thought of as an industrial activity that is in balance, as far as is possible, with other concerns such as environmental protection. Certain statements in the paper may lead one to consider non-renewable development to be an irresponsible and unyielding force having impacts that cannot be controlled.

In contrast, the authors have also supported the multiple use area concept such that development could proceed within certain constraints. Further to this, the World Conservation Strategy states that "conservation and development have so seldom been combined that they often appear - and are sometimes represented as being - incompatible."

In the absence of specific information within the paper concerning the value of petroleum resources and the proposals to explore and develop these resources, evaluation of development in the context of environmental conservation is difficult. The less information available, the greater is the uncertainty. Other sources have estimated offshore oil resources in the Antarctic to be in a range of 15 billion barrels to over 50 billion barrels. These estimates have been criticized and are suspect since there is no way of knowing with any degree of certainty what these figures are until exploration and delineation drilling commence. It should be noted that several companies have requested permission to conduct exploration activities over several years, and that consideration has been given to a moratorium on Antarctic development. As well, in 1977 at a consultative treaty meeting, all states were requested to refrain from exploration and exploitation of antarctic mineral resources until an agreed regime to manage resource development activities, if they were to be permitted, was adopted.

A dilemma posed is that in order to allocate land uses it is highly desirable to know the location and value of all resources. In the case of oil, this is not known until drilling commences. Drilling itself is a use of the land that has potential impacts, particularly from a oil blowout.

Another dilemma faced is that if permission is given to drill, and the oil potential is confirmed, the pressures to produce the resource will be intense and may overshadow environmental protection concerns. If it is assumed that a decision is not made to prohibit such activities, the approach taken should be to set high preformance standards that must be met by operators.

The statement that "technology for recovery of hydrocarbons is not a limiting factor" needs to be questioned, particularly in considering the various phases of development. Exploration drilling may be possible at present, although the open water season is very short (2-3 months) and there are ice hazards that must be considered. If sufficient reserves are identified during exploration, major technical challenges exist in moving to the production and transportation phases. Production and transportation would have to be on an extended season basis requiring permanent facilities. A very thick ice shelf covering large areas for most of the year, moving pack ice and icebergs, and weather conditions will limit the types of technologies that can be used safely. Sub-sea production, storage and transportation systems have not been applied in this type of environment. Another serious question is whether these resources are economic, given the current soft market for oil. In short, significant technical and economic problems remain to be solved in the production and transportation phases. It is also during this phase that the greatest possible environmental problems would be expected.

Environmental impact assessments will be required before an activity should commence, but in the absence of a clear decision-making process, recommendations from such assessments need not be pursued. Uncertainties exist as to the degree of consensus necessary among the various countries having interests in the Antarctica to grant approvals for commercial development. The question of jurisdiction over the continental shelf is a key factor in weighing economic benefits with environmental concerns.

Indigenous and Traditional Forms of Northern Land Use and Their Role in Economy and Heritage by K.V. Abrahamsson

The author has provided some useful conceptual tools that can be applied to an understanding of the relationship of the natural environment, culture and technology. Changes in these relationships are at the root of many of the present day issues associated with the Arctic.

Much effort is presently devoted to trying to balance these relationships. We have seen the growth of environmental impact assessments and the more recent emphasis on socio-economic impact assessments as installation of technologies in the north in support of resources development are being planned.

The concepts contained within the paper are consistent with recent thought and practice in Canadian Arctic. For instance, the Beaufort Sea Environmental Assessment Panel concluded that hydrocarbon development could proceed in an acceptable manner provided that it would be conducted as a small-scale and phased-in development and be subject to certain conditions. This approach can be seen as an attempt to control the pressures of change on the carrying capacity (as defined in its broader sense) and on the capability constraints of the natural environment and social fabric of the north. Rapid and large-scale development could exceed the carrying capacity and capabilities in the north and absorb or manage changes.

The author states that to maintain the carrying capacity in view of the population/resources equation, and in the absence of populating control mechanism, that societies "had to resort to innovative ways of intensifying land use and/or improving technology" or to other ways such as emigration. This theme is particularly germane to an understanding of past cultural changes and provides a framework for looking to the future of renewable resource harvesting.

Examples can be provided from the development of cultures and subcultures preceding the present-day Inuit. The Arctic Small Tool tradition used chipped stone for weapons and tools. Flint was used for spear, harpoon and arrow points and as small blades to cut meat and skins. With a cooling climate, those in the higher latitudes moved south or did not survive. A new culture, the Dorset, emerged in response to these changing conditions of environment and locale. They developed different technologies such as snow knives, sleds and better housing. They adopted or developed technologies to hunt seal, walrus and possibly whales. More sophisticated techniques were later adopted or developed by the Thule culture, which had likely migrated from northern Alaska. Isolation from other groups in time led to variations in culture. As the author has pointed out, Inuit in recent years have adopted a variety of new technologies from the south. The concepts stated by Abrahamsson are in agreement with a very rudimentary sketch of changes in ecotechnology.

In addition to the technologies identified by the author there can be added medical technologies, and the southern value of "maximum life preservation" which have both affected the population/resource equation.

The concepts can also be applied to the future viability of renewable resource harvesting, which will be under increasing pressure from a growing population. Cross-cultural management and technology transfer should be used to provide a south basis for the management of these resources.

Land Claims Objectives Concerning the Management of Parks, Protected Areas and the Renewable Resource Economy by the Tungavik Federation and Nunavut

The paper by Tungavik Federation of Nunavut clearly states the Inuit's position of their need to maintain access to lands and waters used for hunting and subsistence activities. Emphasis is given to the economic rationale of the continued need for a renewable resource economy: it is a major source of livelihood and there are few other opportunities such as wage-employment available.

An obvious missing argument is that of the importance of renewable resource harvesting to the Inuit culture. At a conference sponsored by ACUNS in Banff in 1981, and through other discussions, this appeared to be a crucial consideration, yet difficult to address, at least by a southern/scientific perspective. Naturally, when trying to understand cultural values such as the pride of being a hunter, the role of resource harvesting in community cohesion, the satisfaction of personal, family and community needs, and enjoyment of lifestyles, analysis has its limits. It has been said that cultural values elude usual southern "accounting" systems. By definition, quality of life is difficult to quantify and evaluate. Its importance, however, needs to be recognized and reiterated.

Judging from the progress made by TFN, settlement of the Inuvialuit claim and the recommendations of the Task Force on Northern Conservation, native peoples' perspectives are an integral part of the decision-making process and allocation of land uses. The trend has been to greater local or regional control and ownership of certain lands. There is, naturally, reluctance about these types of changes among certain resource users. In the case of the western Arctic where claims have been settled, there appears to be a good relationship between the Inuvialuit and oil companies. The companies have not been unduly restricted in their activities. Through the Inuvialuit Development Corporation, which was spawned through land claims settlements, business opportunities are being seized to provide income and jobs. How the Nunavut claim unfolds will be of considerable importance to the future of Inuit, other northerners and southerners alike.

General Comments

In addition to comments on the three papers, I am providing the following general views on the Arctic Heritage Symposium. Suggestions provided may be useful in the planning of future conferences.

The community present at this symposium consists of a network of people having scientific knowledge of a unique region. It has a shared ethic of conservation and protection of the arctic heritage. There is a sharing of initiatives to promote this ethic. As an entity, the conservation community must interact at its boundaries with other communities and interests that are users of the Arctic environment, such as resources developers and native peoples. The Task Force on Northern Conservation, discussed in a following session of this symposium, is one instance where these links with other communities has been forged, and it might be said that it has expanded its boundaries of interest to overlap with these users.

The conservation ethic stemmed in large part from the environmental sciences, hence the close links with, and strong emphasis on, natural processes at this symposium. At the periphery of the conservation sphere is the arctic cultural heritage. Also near the perimeter are the users of the northern environment northerners and developers. Northerners in particular are potentially most affected by the deliberations and activities of this group. Participation by resident northern scientists having a different body of knowledge, termed "folk knowledge" based on a "hands-on" approach is not well represented. An apparent result is that again, north and south cross paths, but are not moving in the same direction, nor at the same pace.

It is suggested that the conservation ethic include a more deliberated view that science and conservation should work together in support of the aspirations of northerners. Suggested activities include:

- interested participation by northerners in such symposia and in research activities;
- cross-cultural scientific transfer;
- research directed to resource management questions;
- conducting research according to the priorities of northerners.

Until this attitude permeates our thought and activities as commonplace practices, science may be of marginal interest to northerners.

A trend is emerging, however, in support of improving the relevance of science to northerners. Various initiatives along these lines are being pursued by the Science Institute of the NWT, ACUNS, AINA and the territorial and federal governments. Such initiatives deserve continued support and emphasis.

A Critique of Land Use and Conservation in the Arctic
Session I

Constance D. Hunt

Introduction

I would like to focus my remarks upon two general themes raised in the three papers distributed in advance of this session. The first theme is the importance of people in designing strategies for Arctic land use and conservation. The second relates to the difficulties and opportunities presented when a multiplicity of governments is involved in land use management. As will be seen, in the Canadian Arctic these two subjects are linked in the movement toward resolution of aboriginal land claims.

The Importance of People

Abrahamsson has given us a fascinating overview of the relationship between reindeer and the indigenous populations of Scandanavia. As he points out, reindeer herding has played a relatively minor role in North America. Nevertheless, his explanation of changes that have occurred in Scandanavian reindeer herding provides a parallel for certain recent developments in both Canada and the United States. These will be elaborated upon below.

Abrahamsson states that "natural resources are strongly related to human society." This view is echoed in the Ames paper, which stresses that conservation objectives "should be focussed on the economic needs of the people of the region." Both authors, too, draw to our attention the impact of new technologies upon resource use by indigenous populations. For example, in Finland, we are told that forestry, hydro-electricity projects, and the pressures of tourism have led to such a significant loss of range that artificial feeding of herds has become commonplace. Corral feeding is costly, and as a result only those with outside incomes are able to continue their involvement with reindeer herding.

In the Canadian Arctic, the Inuit lifestyle of hunting, fishing and trapping has been altered considerably by the adoption of snowmobiles, outboard motor boats, rifles, etc. Rather than seeing these developments as destructive of Inuit culture, however, Ames argues that the Inuit "must be able to use the lands and resources freely in a manner that allows them to meet their economic needs." This is part of the rationale for the proposals put to the federal government by the Tungavik Federation of Nunavut (TFN) in relation to Inuit land claims in the eastern Arctic.

The establishment of protected areas in the Arctic has often been viewed as one means of promoting conservation objectives. In this context, the importance of the people/resources relationship is very much in evidence. In Antarctica, there is no indigenous population, and thus the general issue is cast in a somewhat different light. Lucas and Dingwall tells us that a promising beginning has been made in establishing protected areas. However, they suggest that the management objectives for Antarctic Protected Areas may be too narrow, and may need to take into account the protection of sites and cultural, historic, recreational and tourist value. Ames reveals that the Canadian Inuit often view the establishment of Protected Areas with suspicion: they fear that such areas will impede their hunting, due to the imposition of access and hunting restrictions, as well as the loss of economic opportunities associated with renewable resources in such areas. He also points out that the existence of such areas may make only a minor contribution to wildlife protection, due to the migratory habits of certain species and the fact that some industrial impacts (such as oil spills) can easily cross administrative boundaries.

The interplay between people and resources in the Arctic was also recognized by Canada's Task Force on Northern Conservation, which reported in December 1984. It adopted the World Conservation Strategy's definition of conservation:

> Conservation is the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations, while maintaining its potential to meet the needs and aspirations of future generations; it emphasizes the maintenance of cultural resources and representative or unique ecosystems, their ecological processes and genetic diversity (Task Force on Northern Conservation, 1984).

The Task Force noted that comprehensive land claims agreements in the Canadian Arctic provide one mechanism for promoting conservation objectives. Indeed, in view of the Task Force, many of the components of the 1984 Inuvialuit Final Agreement in the Western Arctic (the COPE Agreement) "may be more effective in achieving the goals of conservation than much of the current resource management legislation." For example, the COPE Agreement provides for the establishment of a national park on the Yukon North Slope, wildlife and fisheries management regimes, and a number of new institutions for resource management that will involve both government representatives and the Inuvialuit. Ames has outlined the provisions either agreed to or under negotiation as part of the TFN claim that also have implications for conservation in the Eastern Arctic.

In Canada, the achievement of the COPE settlement, and the ongoing negotiations between the federal government and other northern natives (TFN, the Dene of the Mackenzie Valley, and the Yukon Indians) have occurred pursuant to the federal government's 1981 policy on comprehensive aboriginal claims, entitled *In All Fairness.* Only one claim, that of the Inuvialuit, has been settled pursuant to the policy, despite the passage of several years and the expenditure of considerable time and resources. The policy is currently being reviewed by a five-member Task Force which is to report to the Minister of Indian and Northern Affairs by 30 November 1985. Some of the issues emerging from the policy review bear upon the relationship between conservation and indigenous resource use. A few will be touched upon here.[1]

Canadian government policy toward aboriginal claims traditionally has been directed toward the notion of extinguishment of aboriginal rights. This is clearly the case with the early Indian treaties, and is also evident from both the James Bay and Northern Quebec settlement of 1975 and the recent COPE Agreement. However, amendments to the Canadian constitution in 1982 take a different approach: the new s.35 specifically recognizes and protects aboriginal rights.

The other useful example comes from Alaska, where the 1971 Alaska Native Claims Settlement Act was intended to enable natives to become part of main-stream society. A review of that settlement has recently been completed by Vancouver lawyer Tom Berger, under the auspices of the Inuit Circumpolar Conference. The results will be published shortly, but are expected to emphasize the fact that the underlying theory behind the settlement - the notion that native people should become like us - has been one of the reasons why the settlement has been viewed as a failure by many Alaskan natives.

Related to the goal of extinguishment in the current federal policy is the idea that land claims settlements should be final arrangements. The above examples also demonstrate that this may prove impossible. In this context, it is interesting to note that the TFN proposal has called for renegotiation of Inuit Impact and Benefit Agreements within Protected Areas, at seven-year intervals (Ames). This approach seems more realistic than the idea of "final" agreements, given our experience elsewhere.

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[1] Any views expressed concerning the comprehensive claims review are those of the author alone and not the Task Force.

The comprehensive claims policy review has given rise to another issue, alluded to in the Ames paper. This is the extent of which native people may have rights in the offshore areas. To date, the position of the federal government has been that offshore areas will not be included in settlement agreements. Indeed, this issue remains partly outstanding in regard to the James Bay and Northern Quebec Agreement. The recent controversy over Canadian sovereignty in relation to the Northwest Passage casts an interesting new light on this subject: some experts have suggested that the Canadian claim is very much strengthened, in law, because of traditional Inuit use and occupancy in the disputed area (Pharand, 1984). If Canada chooses to rely upon this traditional use in defending her claim before the international community, it will be difficult to deny the Inuit position that the offshore should be included in claims negotiation.

Both the COPE and James Bay Agreements have recognized the need to protect special hunting, fishing, and trapping rights for natives. TFN has also negotiated a Wildlife Management Agreement-in-Principle (Ames) which protects special rights for the Inuit. The Alaska Settlement did not recognize the importance of the subsistence lifestyle for natives (from both a cultural and economic viewpoint), and has been heavily criticized as a result. It is interesting that in Finland, where reindeer herding was not recognized as a special prerogative of the Saami, it has now ceased to be part of their lifestyle (Abrahamsson). The fact that the issue of special subsistence rights will not disappear is demonstrated by the Indian reaction to the establishment of Wood Buffalo National Park as a World Heritage Site in August, 1985. The concern has been expressed that this designation may impede the Indian hunting and trapping lifestyle.

In the Canadian Arctic, the recognition of special wildlife rights for natives in the land claims agreements has resulted in the establishment of wildlife management bodies where both natives and government managers are represented. This seems to me to be a major step, when one considers that only ten years ago northern wildlife laws were amended with little or no involvement by local users. The comprehensive claims Task Force has been asked to consider another matter that is relevant to the establishment of such bodies, namely, the extent to which land claims agreements might be implemented in part, prior to the completion of negotiations in all topics. To date, the government's approach has been that no part of an Agreement-in-Principle can be implemented until all parts have been agreed. Whether this is realistic, given the length of time claims negotiation appear to take, is one topic being addressed by the Task Force.

Multiplicity of Governments

In the Canadian Arctic, the existence of two main levels of government (federal and territorial) has posed constant difficulties for land use matters. The Task Force on Northern Conservation noted the complexities caused as a result and recommended that responsibility for management of freshwater fisheries be transferred to the territorial governments. The Task Force also recommended that the land-use planning agreements between the territorial and federal governments be implemented as expeditiously as possible. The current process of devolution in our northern territories, and proposals to divide the NWT pose both opportunities and challenges in the area of land use and conservation.

In this context, it is encouraging to consider what has been accomplished in regard to the Antarctic. The diversity of interests among the involved governments, and the large number of actors, make the achievements there extremely impressive. The fact that a resource management scheme (albeit an imperfect one, from the Lucas and Dingwall perspective) has been agreed and implemented with considerable success, should be some cause for optimism that similar results can be achieved in this country.

In the Canadian Arctic, however, the situation may be somewhat more complicated by the aspirations of the indigenous populations. The Task Force on Comprehensive Claims has been asked to review the matter of native self-government, and its relationship to the claims process. Aboriginal self-government is also being actively addressed in Canada at the constitutional level, through the conference of first ministers. The recent failure of that body to reach consensus on self-government, however, may mean that the matter will become increasingly important at the land claims negotiating table.

Finding an area of agreement on this subject between the many affected parties may prove to be one of the Task Force's most difficult tasks. Regardless of the outcome, however, it seems to me that we might be able to learn from the experience in the Antarctic, and I invite a further exploration of this subject.

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Summary of Discussion on Land Use and Conservation in the Arctic: Session I

Editors

Discussion focussed on a number of topics central to the evolution of Inuit culture. Much attention was devoted to the impacts of electronic technology in its many forms on Inuit communication patterns. It was stated that most affected Iniut accept the new technology and exhibit a remarkable understanding of its power and potential, particularly electronic printing and publishing in Innuktitut. Concern was articulated that northern electronic media may eventually have to be subjected to content regulations so that native, domestic and foreign programming reflects northern cultural goals and aspirations.

The discussion of native peoples' perceptions of national parks and protected areas was animated. It ranged from commentaries on aboriginal title and native rights to a comparison of Australian and Canadian experience with the land claim settlement process. It also involved Inuit desire to continue hunting and other activities, perhaps with a commercial component, in national parks and related reserves created in the Canadian North. Frustration stemming from the lack of progress in formalizing native participation in future national park management was expressed. Several participants indicated that existing Canadian federal legislation would not permit such an arrangement. In addition the implications for native cultures of primarily developing a non-renewable resource economy rather than a renewable resource economy were discussed.

Land claims settlement was mentioned as the major obstacle to the establishment of new, northern, national parks yet the new Yukon North Slope National Park was created as part of a land claims agreement. It was noted that national park establishment problems occur in all countries, and that the land claims issue was neither unusual nor unique to the Canadian situation.

The session concluded with a brief review of the similarities and differences between Arctic and Antarctic management experience. International agreements related to the 1959 Antarctic Treaty were described and the suggestion was that made these provide lessons for the Arctic.

LAND USE AND CONSERVATION IN THE ARCTIC: SESSION II

Caribou near Wager Bay
Courtesy: Murray McComb

Northern Conservation Strategy

R. Schwass, J.T. Inglis and J.K. Naysmith

Northern Conservation Strategy

Work on the development of a comprehensive conservation policy for northern Canada began in 1982. The purpose of this paper is to outline the origins of this initiative, to describe the process that was followed and to report on the progress that has been made.

The Department of Indian Affairs and Northern Development (DIAND) has had limited success over the past ten years in dealing with proposals to establish protected areas north of 60° N. Seven major interests have submitted, or intend to submit, extensive lists of geographic areas which, in their view, merit special consideration. In reviewing the government's achievements, it is apparent that relatively little progress has been made in dealing with parks proposals or in identifying, establishing and protecting critical or special areas. A discussion paper was prepared (Inglis, 1982) to stimulate departmental thinking on its role as "northern landlord" in dealing with this situation. This was the first phase of the policy development process. Although the paper was conceived as an internal, rather provocative, working document, widespread government and public interest in the subject led both to the broadening of the subject under review and the debate surrounding it. The challenge, then, became one of focussing an often acrimonious debate and drawing upon the knowledge and expertise of the many interests involved at a time when conservation was seen as an obstacle to orderly northern economic development. The problem was exacerbated when a small "technical" workshop of twenty-five people planned for the neutral setting of Banff became a large meeting of eighty-five in Whitehorse, Yukon, in February, 1983, where the occasion opened in noisy protest and placard waving. In the end, the meeting was a success, largely through the use of the Search Conference process.

The process, and its applications, has been summarized by Schwass (in press), Trist (1980) and Williams (1979). In essence, a Search Conference is a workshop which involves all key stakeholders in a complex planning situation. It was developed in the early 1960s for corporate strategic planning, and it has been widely used since that time for social planning purposes. While each event is designed specifically to meet the needs of the situation, the process usually takes the following form.

Participants in the Search Conference are key decision-makers in organizations which have an important stake in the situation. Key background materials supplement their personal knowledge of the issues to be discussed. Participants are assigned to small groups, each of which is a microcosm of the large group. After a brief introductory plenary session, the small groups examine the present situation and attempt to reach agreement about the issues. They then try to explore the future situation (perhaps to the year 2000), if nothing is done to change present trends. The group reports are brought together in plenary session, so general agreement can be reached.

In the second session, the small groups try to agree on a desirable future to the year 2000 (or the selected target date). This desirable future is shared in plenary.

In the third session, the constraints and obstacles to achieving the desirable future are discussed in detail in the small groups and then shared in plenary.

Once the constraints and obstacles have been identified, the groups undertake the task of identifying opportunities to release the constraints or circumnavigate the obstacles. When the groups have finished, they share their ideas in plenary session.

The final sessions, in small groups and plenary, are devoted to developing a list of action steps and even a plan of action, if that is possible.

At the Whitehorse workshop the DIAND discussion paper was used as the key background document and attention quickly moved away from a consideration of past problems to a consideration of northern conservation needs. The result was an Action Plan (DIAND, 1983), which marked the completion of Phase II of our policy development process and set the stage for Phase III.

The Action Plan recommended that the Minister of DIAND in consultation with the appropriate federal Ministers and the appropriate Ministers in each of the territorial governments, appoint a balanced Task Force of senior government officials and non-government persons who had appropriate qualifications. It was envisaged that the Task Force would identify appropriate conservation targets for implementation over the following two years, and advise on the establishment of an ongoing mechanism for conservation having appropriate links to the northern land use planning process.

Subsequently, a Task Force was formed which met in November, 1983 to consider:

1. a framework for a comprehensive conservation policy for northern Canada, including both terrestrial and marine components;

2. a strategy, and ongoing mechanism, for implementing the policy; and

3. specific actions that could be taken over the next two years.

There were eleven members, six of whom were northerners. The membership reflected industry, conservation, territorial government and federal government interests; all of the members had considerable experience and knowledge of conservation and development issues.

At the first meeting of the Task Force, a mini-Search Conference was held to develop a plan of action for the following year. In that session, we resolved many of the apparent conflicts and set our own agenda. That agenda was followed throughout our work and helped keep us on track. The product was the Task Force Report (Task Force on Northern Conservation, 1984).

The 48 page document deals first with an analysis of the problem areas that must be addressed if a northern conservation strategy is to be successfully developed and implemented. These include:

1. reliance upon a regulatory system that tends to be restrictive, narrow and reactive rather than on an active, forward looking approach to resource management;

2. institutional competition between governments and among government agencies;

3. failure to consider adequately resource values - social, cultural and economic - and alternative choices as they apply to both development and conservation initiatives prior to making land-use decisions;

4. insufficient opportunity for northerners to participate effectively in the decision-making process involving northern resource utilization;

5. legislation for the disposition of land, forests, water and non-renewable resources that is deficient with respect to conservation measures such as planning, management, protection and restoration; and

6. lack of sustained political commitment to ensure that resource-use decisions reflect conservation requirements.

The Task Force adopted a broad definition of conservation, based on the *World Conservation Strategy*, focussing on two components: one dealing with the wise use of resources the other dealing with the establishment of protected areas. The following principles and goals were established:

Principles

1. genetic diversity of natural organisms and essential ecological processes should be maintained;

2. resource management should reflect the concept of stewardship and should be aimed at achieving the integrated use of resources to the extent they can be made mutually compatible;

3. sustainable utilization of species and ecosystems should be assured for the benefit of the people of the North, as well as for all Canadians; and

4. projected benefits should meet the needs and values of the people of the North, as expressed through their participation in the conservation and development processes.

Goals

1. to manage the human use of natural resources, renewable and nonrenewable, so that they may yield the greatest sustainable benefit to present generations, while maintaining their potential to meet the needs and aspirations of future generations; and

2. to establish a network of protected areas where necessary to maintain in perpetuity cultural resources and representative or unique ecosystems, their ecological processes and genetic diversity.

To give effect to the conservation goals that it recommended, the Task Force proposed adoption of a strategy consisting of two mutually-supported components - a system of integrated resource use, and a comprehensive network of areas that require measures of special protection. Together, these two components would form a conservation strategy for all land, fresh water and marine areas of the Yukon and Northwest Territories.

Philosophically, this approach recognizes the ecological and intrinsic values, as well as the economic values, of all natural resources. Practically, it accepts the need for a goal-oriented, problem-solving approach to resource management and recognizes the need for protecting particularly sensitive or unique areas as part of that management approach. Institutions must develop ways of building conservation into all resource policies, processes and activities.

The Task Force perceived the two basic components of integrated resource management and protected area management as mutually dependent upon, and supportive of, each other. This mutually supportive relationship of the components is based upon at least two considerations. One is that even the most highly protected areas of land and sea cannot be maintained as undisturbed "islands" if the surrounding areas are not also managed wisely. The second consideration is that resource management generally can be improved by knowledge gained from the protected areas when the latter are used for education, research or places to record long-term natural changes.

To give effect to these goals, the Task Force made seven major recommendations in the belief that all of them can be implemented within two years, given strong political support. They deal with a conservation strategy and ways to implement it. The strategy involves the implementation of an integrated resource management process, focussing on areas of resource use conflict, and the early establishment of a comprehensive system of protected areas. Eight implementation measures or procedures are proposed, the most important of which are the emerging land use planning process and land claims agreement. Others include the use of conservation management agreements with industry, communications and research programs, new or amended legislation and various institutional changes.

The report in essence represents a constructive compromise amongst a wide range of government and non-government interests: the seven major recommendations pose a challenge to both territorial governments and federal government to establish and implement a comprehensive conservation policy.

Responding to the challenge involves broad consultation and extensive dialogue with native organizations, governments, industry, conservation groups and other interests. This consultation is particularly important, for we are no longer speaking simply of fitting together a patchwork of protected areas in the north in response to the proposals of various interests, but considering new or alternative approaches to the management of natural and cultural resources in 40% of Canada. It is our view that if policies and strategies are to have any meaning, they must be acceptable and actively supported by communities, regional, territorial, and federal governments. They must also be accepted to landowners, resource users and managers, and to politicians.

It became clear, very quickly, that we are in fact dealing with two conservation policies: one tailored for the Northwest Territories and one for the Yukon. This is a reflection of the political, socio-economic and cultural environment of these two quite distinct territories. The two territories have approached the matter quite directly. The Department of Renewable

Resources, Government of the Northwest Territories, responded enthusiastically to the report. Follow-up action includes work on integrated resource management planning, protected area establishment and management, the implementation of joint regional land use planning, and communications programs. This is a major effort on the part of a relatively small organization, an effort which should see substantial results within the two-year action plan. There are two specific projects that are seen as especially significant. One deals with the feasibility of establishing an integrated network of protected areas in the NWT, and the other, an examination of conservation management agreements between Government and the mining industry.

In the Yukon, a recent change in government has meant that there has been limited opportunity so far for exploring new initiatives. The new government has endorsed the principles, goals and overall strategy set out by the Task Force and we expect that an action plan will emerge shortly. The major response in the Yukon has come from non-government organizations and from Yukoners themselves. This is particularly gratifying for it epitomizes the territorially based initiative required to implement a conservation policy. The response took the form of a workshop in Whitehorse earlier this year. This meeting differed in a number of responses from the workshop held in 1983. First, virtually all of those attending the recent meeting were Yukon residents, whereas in 1983, the majority of participants were from the south. Second, there was participation this year from the territorial government: politicians, senior officials, scientific and technical staff, whereas in• 1983, the territorial government boycotted the meeting. Third, this year's meeting gave equal weight to making progress on the conservation of protected areas and to the conservation of heritage resources, whereas the 1983 meeting was concerned with the development of an action plan. Fourth, this year the meeting was open to all Yukoners, whereas the 1983 meeting was by invitation. While the non-renewable resource community showed little interest in attending this time,, in 1983 some groups were "breaking down the doors" to give voice to their concerns.

The product of this effort is a report to be presented as part of the National Parks Centennial Canadian Assembly in Banff, 4-8 September 1985 (Yukon Caucus, National Parks Centennial Project, 1985). It is hoped that this contribution toward a system of protected conservation and heritage areas in the Yukon will be endorsed by governments and other participating groups and form the foundation for Yukon conservation policy development. Most encouraging in all of this, however, is that there have been substantial changes in attitudes, over the past two years, in a territory where conservation has often been equated to a "land grab," or viewed as being diametrically opposed to economic development.

At the federal level, the response from the Department of Fisheries and Oceans (DFO) has been outstanding. The Minister offered his personal support for the establishment of a comprehensive conservation policy in cooperation with territorial governments and native organizations.

DFO has accepted responsibility as the lead agency for arctic marine conservation and for providing leadership through policy direction, identification of conservation requirements, establishment of marine protected areas, coordination of interdepartmental activities, promotion of marine conservation, nationally and internationally, and public information. Work is currently underway to put these commitments into effect. This is a major breakthrough in working towards a northern conservation policy. Our efforts over the past two decades have focussed largely on the terrestrial environment. We are now in a position to realize a major recommendation of the Task Force by addressing marine conservation needs. We predict that major gains will be made over the next two years towards meeting these needs.

The Department of Environment, with responsibilities for National Parks and for migratory birds, has made a commitment to take decisive steps to protect important areas in the near future. We anticipate that plans setting out these steps will be made public soon, following an evaluation of departmental conservation objectives.

In responding to the challenges posed in the Task Force report, DIAND is collaborating not only with Canadian interests, but with international ones also. The department is actively evaluating the biosphere reserve concept in cooperation with the Canada MAB Committee, for it is felt that this approach could be most valuable in dealing with resource management issues over extensive areas. We are collaborating with World Wildlife Fund (Canada) to determine how we can work with northern communities to effect sound resource management plans for marine mammals through the establishment and management of specially protected areas.

A number of the ways in which governments have responded to the Task Force Report and pursued policy development and implementation have been outlined. Good progress in Phase IV of the task has been made and it is likely that within the next year, some of the difficulties which have faced us for many years will have been mastered. It would have been desirable to have moved faster in some areas, such as the protection of historical resources and in working with native organizations to see how land claims settlements might be effective tools in achieving conservation goals. These challenges remain to be met.

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Task Force on Northern Conservation Report: An Evaluation From the Perspective of the Canadian Sub-Arctic International Biological Programme

Richard Revel

Introduction

In December 1984 a major Task Force Report on Northern Conservation (Task Force on Northern Conservation, 1984) was published by the Federal Government of Canada. This report comprises the single most significant document published and widely circulated by the federal government on the issues surrounding conservation and preservation on Canadian land north of 60° N latitude. The report, if acted upon by the federal and territorial governments in the spirit in which it was intended, could set the stage for one of the greatest pieces of conservation planning of largely unaltered lands anywhere on the globe.

Approach to the Evaluation

The stage will be set for the evaluation by providing an historical review of the International Biological Programme, defining the mandate given to the two northern panels of the Canadian IBP and outlining the purposes and uses of ecological sites in northern Canada as perceived by the Sub-arctic IBP panel. Having thus provided the reader with information on the IBP and its proposed ecological sites, the Task Force Report will be evaluated at two different levels:

1. A general evaluation which covers the Terms of Reference of the Task Force, the composition of the Task Force, the Task Force's definition of their problem and the problems confronting any conservation/development efforts in Canada's northland.

2. A specific evaluation of the Task Force Report and its implications to the future of the Ecological Areas defined by the Sub-arctic IBP panel.

Background of the International Biological Programme

In 1965 the Canadian Government officially joined the International Biological Programme (IBP). The IBP was established to document the range and productivity of world ecosystems and to direct efforts toward the conservation and preservation of representative examples of the entire array of such ecosystems on a world-wide basis before they are irreversibly altered by man's activity. Prior to this time there had been no significant international effort to determine what natural resources man was dependent upon for his existence. Many natural ecosystems were being exploited by man before we even understood the most basic of their dynamic properties. Without such scientific knowledge mankind was in a position of not understanding the consequences of his actions. The wellsprings of the International Biological Programme were thus directed toward assisting man in undertaking the development of nature on a sound scientific base. The IBP and its conservation efforts were neither pro-development nor anti-development and were thus concerned with the long term wellbeing of mankind.

The IBP in Arctic and Subarctic Canada

To inventory Canada's ecosystems methodically, Canada was divided into ten regions, each with the administrative and scientific responsibility for inventorying their particular area. In 1969 an arctic and sub-arctic panel were set up for the federal lands north of 60° Between 1969 and 1974 the two panels documented a total of 152 sites which they felt represented significant ecosystems (Beckel,1975; Nettleship and Smith,1975).

The Mandate of the Two Northern Panels

In summary, the mandate given to the two northern panels by the federal government was:

1. To locate and describe representative and/or unique examples of natural ecosystems in cooperation with local residents, industries, scientists and the federal and territorial governments.

2. To demonstrate the biological value of each site.

3. To provide assistance to the territorial and federal governments in developing guidelines for the recognition and management of these areas as Ecological Sites.

Purposes and Uses of Ecological Sites

The purposes and uses are indeed numerous and have been elaborated upon in many publications (Franson et al.,1971; Fuller,1972; Krajina,1972; Brice-Bennett,1973; Peterson,1973; Strang,1974; Henry,1975; McLaren and Peterson,1975; Dickinson and Simmons,1976; Revel,1978,1981).

The purposes and uses may however be summarized as follows:

1. Provision of research and educational areas for the biological study of successional trends, evolution of species, interspecific and intraspecific relationships and the dynamics of undisturbed natural ecosystems.

2. Provision of research and educational areas for the scientific study of other aspects of the environment such as meteorological, geological, geomorphological, cryogenic and pedological processes.

3. Provision of research and educational areas for the scientific study of recovery processes in ecosystems which have been modified by man's activity (mining, settlements, petroleum, hunting, roads, etc.).

4. Provision of reservoirs of natural living material and a protected genetic pool for native and/or endangered species of plants and animals and their habitats.

The initial views of the northern International Biological Programme panels were that each of the Ecological Sites would become areas where both long term and short term research could be conducted on a whole array of topics bearing on how particular ecosystems function. It remains our hope that once established, these sites will become focal points for research by credible scientists from industry, government, and universities and further that researchers not be restricted to those of Canadian origin but rather reflect the interests of the much broader international research community. To put it another way, these sites will become knowledge benchmarks; reference points which can be used for guidance on how a particular activity affects the natural system.

The importance of having protected natural gene pools from which to draw or develop plant varieties for reclamation purposes must rank as a very important use of ecological sites. Developed countries have spent billions of dollars constructing gene banks and seed storage facilities. Such facilities are outlandishly expensive to maintain and are unable to preserve even a tiny fraction of the diversity contained in a small ecological site. Genetically, Ecological Sites are "money in the bank" and will function as future gene sources for man's use.

Has the IBP Fulfilled Its Mandate?

Progress can be judged in light of the three-part mandate given to the two northern panels by the federal government in 1969.

First, we have indeed located and described both representative and unique natural ecosystems in cooperation with local residents, industries, scientists and both federal and territorial governments.

Second, the location of these sites and very brief summary descriptions have been published and made available to interested parties since the mid-1970s. More detailed information has been available upon request from the respective panel chairmen (myself for the Subarctic Panel and Dr. John Lambert at Carleton University for the Tundra Panel).

The third point in our mandate, that of providing assistance to the two territorial governments and the federal government in developing guidelines for the recognition and management of these Ecological Sites, has been and continues to be the major thrust of the two northern panels. Fulfilling this part of the mandate is a much slower and more time-consuming task if for no other reason than the immense number of interested parties involved - each with their own vested interests.

It is important to note that the role of the two northern IBP panels is quite different now than it was during the early part of the IBP program. The panels were never charged, nor should they have been, with the task of deciding which sites must be formally designated. That task must rest squarely upon the shoulders of the Yukon Government, the NWT and the Federal Government of Canada. Advice and direction from the IBP panels has been and continues to be sought by the federal and territorial governments as well as other interested parties and individuals across the country.

The two northern panels will continue to operate until their initial mandate is fulfilled.

Origins of the Task Force on Northern Conservation

Since 1969 successive Ministers of DIAND have stated that a network of Ecological Sites will be established across northern Canada - the commitment is there and Canada's responsibility to the international community remains. Only one Ecological Site has been declared to date.

In 1983 a draft Northern Conservation Policy and Strategy was written, circulated very widely across the country and then discussed in detail at a workshop convened by the Department of Indian and Northern Affairs in Whitehorse in 1983. The workshop was attended by approximately 100 people representing the diversity of interests across the country. The intent of this workshop was neither to endorse nor to reject the draft document from DIAND but rather to suggest ways to improve it, raise areas of concern and give the respective governments direction on how to proceed. One of the recommendations to the Minister of DIAND was that he strike a Task Force on Northern Conservation with a broadly based composition. The specific recommendation emanating from the Whitehorse Workshop stated:

> It is recommended that the Minister of Indian and Northern Affairs, in consultation with the appropriate federal ministers and appropriate ministers in each of the territorial governments, appoint a balanced task force of senior government officials and non-government persons who have appropriate qualifications.
>
> The Committee would operate until December 31, 1983 and, during that time, would : (a) identify appropriate conservation targets for implementation through 1985, and (b) advise on the establishment of an ongoing mechanism for conservation having appropriate links to the northern land use planning process.

An Evaluation of the Report: General Evaluation of the Terms of Reference, Composition and Problem Definition of the Task Force

Terms of Reference for the Task Force

The initial terms of reference were very specific and directed the Task Force to "provide advice to the Minister of Indian Affairs and Northern Development on the following matters:

1. A framework for a comprehensive conservation policy for northern Canada.

2. A strategy, and ongoing mechanism, for implementing the policy.

3. Conservation targets which can be met over the next two years."

After examining these terms of reference the Task Force made two very significant modifications. To task 1 above, the qualifying phrase "including both terrestrial and marine components" was added. Although technically this addition was unnecessary it was a useful addition as it clearly indicates to the Minister that marine life and marine ecosystems must be significant considerations in any conservation and preservation programme, something that has not been the case in past Canadian conservation efforts as shown by the paucity of marine parks and ecological reserves in this country. Further, the addition has significant implications from the administrative perspective as the Federal Department of Fisheries and Oceans must become more involved in conservation and preservation efforts. The modification also serves to emphasize that present government administrative responsibilities will have to be adapted to accommodate marine conservation areas (parks, reserves, or equivalents) which may be contiguous with land based conservation areas. Under present government administrative structures, management of such areas is difficult as different federal departments exercise administrative and management responsibilities over land, marine and wildlife components of the environment.

The second alteration the Task Force made to the original terms of reference was to change point 3 from "conservation targets which can be met over the next two years" to "specific actions that could be taken over the next two years". It could, and undoubtedly will, be argued by many that this modification has the effect of reducing the report's significance and removing the sense of urgency for the federal government to declare conservation and preservation areas quickly before it is too late. The original recommendation which emanated from the Whitehorse Workshop that this be one of the Task Force terms of reference was to some degree provoked by the federal government's lack of action in the whole area of northern conservation and preservation.

The Task Force justifies this alteration by stating that to adhere to the original term of reference would be inappropriate as it would by-pass the land use planning process recently negotiated between the two territorial governments and the federal government. Their point is well taken as the selection and designation of conservation areas should and must be made in light of overall land use planning. On a closer review of the Task Force report, most notably the Recommendations section, it is clear that the Task Force has not reduced the sense of urgency in the drive to designate conservation areas. They have in fact made very specific recommendations which they believe can and should be accomplished within a two-year time frame. They have at the same time recommending that the government undertake investigations into issues that are essential to the long term management of conservation and preservation areas but that require more than two years to accomplish.

A further argument in support of the Task Force alteration of the third term of reference relates to political considerations between the two territorial governments and the federal government. For the federal government to act unilaterally in declaring conservation and preservation areas without negotiation and the full consent of the territorial governments would be unduly high handed and indicate a colonial attitude to the territorial governments, both of which are evolving politically and will inevitably ultimately be responsible for the management of any such areas. Political evolution from the status of territories to provincehood is inevitable in the long term.

Composition of the Task Force Membership

Critical to the evaluation of any report that develops and recommends policy and action to a democratic government or governments responsible for carrying forth the wishes of their constituents is the question of bias and composition of membership on the task force. In examining the individual membership of the task force responsible for generating this report, it can be fairly stated that a great deal of care was exercised in selection. Representatives of the extractive resource sector, the conservation lobby, the independent business sector, the political sector of the northern territories, native Canadian organizations, and bureaucratic interests from the Federal Government of Canada were selected to constitute the committee. Looking at the qualifications of individual members for the task they were charged with, it is noteworthy that a very broad base of academic, political, and industrial experience was represented. This is also apparent upon reading the report and recommendations - the report is both pro-conservation and preservation while also being pro-development.

That such a diverse group of individuals and interests generated a report of high calibre with such political acumen is both amazing and laudable. That is not to imply that no argument can be found with it; on the contrary, there are many components that are disagreeable. It is the fact that no one will be fully appeased by the report that suggests the report is reasonably representative of all interests, generally unbiased and worthy of generating some political action. Finally, that the Task Force sought and received submissions and background documents from a broad spectrum of interests to assist them in their deliberations is shown in Annex D (page 46) of the report.

Problem Definition by the Task Force

In defining the nature of their problem, and the problem confronting any conservation/development efforts, the Task Force has enumerated several highly relevant points which must be addressed in the process of putting an integrated policy, strategy and plan into full effect.

The first component of the problem as defined by the Task Force relates to the government reliance upon a regulatory system that tends to be restrictive, narrow and reactive rather than an active, forward-looking approach to resource management. In making this point the Task Force has put its finger on one of the central problems. Their diagnosis is correct, but what the long term prognosis is for the ailment is highly dependent upon the desire of the patient to get better. If past performance is any indication, the long term prognosis looks bleak due to lack of a sustained political commitment to ensure that resource-use decisions reflect conservation and preservation requirements. This rather bleak prognosis is made bleaker by, as the Task Force notes, "institutional competition between governments and among government agencies". It is an acknowledged fact that there is a great deal of animosity held by northerners and northern territorial institutions towards the federal government because of the immense political authority it holds. The federal government is loath to release much authority until such time as the territorial governments are seen to be adequately prepared and in a solid position to take control of their political destiny. With the present population and economic base, and considering the vastness of the land mass of the two territories (most notably the Northwest Territories), it appears that the two territories are not yet in a solid position to govern totally, although this is changing. Looking at the long term, it is inevitable that the two territories will eventually become independent provinces once their economic lot improves and their population increases.

The Task Force report defines two further components of the northern conservation/development problem:

1. failure to consider adequately resource values - social, cultural and economic - and alternative choices as they apply to both development and conservation initiatives prior to making land use decisions, and

2. legislation for the disposition of land, forests, water and non-renewable resources that is deficient with respect to conservation measures such as planning, management, protection and restoration (p. 12).

A Specific Report Evaluation Relative to Proposed IBP Sites

In evaluating the report from the perspective of the Sub-arctic International Biological Programme, a number of specific questions must be addressed to determine if the Task Force recommendations to the Minister are to facilitate the designation of Ecological Sites in northern Canada.

- Has provision been made for the inclusion of IBP recommended sites in the northern conservation report?

- Are the conservation classifications under which IBP Ecological Sites would fall consistent with the original purposes of the IBP?

- Has the committee made provision for the designation of IBP proposed ecological areas which may coincide, in whole or in part, with other categories of protected areas?

- Is a mechanism suggested whereby different levels of protection, commensurate with the intended goals of specific IBP sites, may be accommodated?

- Does this mechanism adequately allow for the selection of alternate sites if conflicts exist with other potential land uses or alternate, but better, ecological sites are located as a result of further research?

- Has an adequate mechanism been recommended for the evaluation of the proposed ecological sites prior to designation?

- Is an adequate mechanism recommended for implementation of the proposed conservation strategy?

The definition of conservation adhered to by the Task Force, the first premise of the report, is entirely consistent with the IBP. It acknowledges that preservation of selected areas is important and equally that development of other ecosystems for the production of goods and services for man's use is essential.

The Task Force report is more specific about its commitment to the Ecological Sites proposed by the Sub-arctic IBP panel in the statement:

> Over the past decade, considerable attention has been given to the importance of designating and protecting ecologically sensitive areas in the Yukon and Northwest Territories. To date, however, no such areas have been established. The Task Force believes that this component of the protected area network should be an integral part of a northern conservation strategy. Although usually small in size, such areas are important because they contain representative, unique or sensitive components of educational or research value, or sites of genetic diversity.

In addressing the question, "Are the proposed conservation classifications under which IBP sites could be designated consistent with the original purposes of IBP sites?" it is noteworthy that the task force has recommended a specific protected area class, "Ecological Areas" under which IBP proposed sites would fall and would be designated. The components of such ecological areas, as defined by the Task Force, may include: outstanding and unique landmarks with site specific features such as pingos, fossils, mineral springs; outstanding and representative landscapes, coastlines, mountains, unglaciated terrain and other representative land-forms; habitat for rare or endangered species such as whooping crane, peregrine falcons and polar bear; representative, unique or sensitive areas for education and sites for the preservation of genetic diversity such as seed, plant and animal collection areas.

The list of components which the task force perceives would fall within their "Ecological Areas" category is very comprehensive and consistent with the perceptions of the Sub-arctic IBP with one notable and important exception. All components listed above deal exclusively with natural environment and omit the inclusion of cultural aspects such as examples of early human settlement and land use or more recent areas of human disturbance where natural regenerative processes may be monitored to provide guidance pertaining to past land uses. This is a serious omission from the IBP perspective.

One of the concerns often raised by the Sub-arctic IBP panel relates to the designation of ecological areas which coincide in whole or in part with areas which already received some level of protection under other categories such as National Parks, National Wildlife areas and Migratory Bird Sanctuaries but which do not presently provide adequate protection commensurate with status as ecological areas.

Many of the proposed IBP sites in northern Canada are in this situation; for example the proposed Anderson River Delta ecological site is presently a Migratory Bird Sanctuary and four ecological area proposals in the St. Elias Mountains presently are included totally or partially within Kluane National Park. Collectively such areas constitute a very significant percentage of the total land area recognized as important by the Sub-arctic and Arctic IBP panels. It is significant that many of these IBP proposals which duplicate existing protected areas were submitted as IBP sites by government scientists who felt present designations did not provide adequate protection commensurate with the ecological significance of the area.

The Task Force Report recognizes the issue and in the discussion of protected area guidelines (p.19) it specifically notes:

> iii) several classes of protected areas should be incorporated within a single designated area where possible.

The report does not however adequately address the issue of "seniority of classification" or "multiple designation" but does imply that this issue should be addressed by a conservation advisory board and a Cabinet Committee of Federal Ministers having responsibility for managing or administering land.

It is under the issue of multiple designation that proposed ecological areas which coincide with areas significant to our cultural heritage could be designated.

Is a mechanism suggested whereby different levels of protection commensurate with intended conservation goals defined by the IBP for specific site proposals, may be accommodated? The Task Force Report has specifically addressed the issue of permanency of protection of their Protected Areas categories although they make no attempt to define levels of protection among various categories.

> ...protected areas would be designated in order to preserve their primary use for cultural, scientific, educational, aesthetic, recreational or biological purposes, so as to maintain natural conditions or preserve certain features... Such protection might be permanent, seasonal (as in the case of caribou calving or migration routes) or temporary, depending on the circumstances. Within each protected area, primary and secondary uses would be identified and secondary uses permitted when compatible with the primary use of the area

The task force position and recommendation on this matter is entirely consistent with the position the Sub-arctic Panel has taken for over a decade. The Panel felt that management and use of proposed IBP ecological sites could not be designated on a universal basis but rather must reflect the needs of particular noteworthy attributes for which the site was originally proposed. Thus acceptability of alternate uses must be decided on a site specific basis and be defined in site specific management plans. The sub-arctic IBP Panel's position on this matter is somewhat at variance with the traditional notion of preservation areas; however, it was taken because of the migratory nature of some of the animal resources which the ecological areas were proposed to protect (notably caribou herd requirements). When proposing such areas, Sub-arctic IBP Panel scientists felt it both inappropriate and unnecessary to seek absolute protection over the very large areas necessary for migration. Compatible alternate uses within ecological areas would be acceptable and appropriate, providing they did not conflict with the site attributes for which the proposal was initially suggested.

The Panel's position, and the position of the Task Force on this matter, must not pass without a very strong note of caution and concern. Such a policy if applied to preservation areas, though theoretically acceptable, is fraught with possible misinterpretations and misapplications at an operational level unless a very strong mechanism for evaluating acceptable alternate secondary uses in light of the primary use is put in place. No mechanism is presently in place and until such is established, any interim land use applications will continue to be taken on a considered, though somewhat "ad hoc" basis without full consultation. Under the present method, proposed site values could be degraded as a result of incremental development.

In proposing ecological areas, the Sub-arctic IBP panel was aware of the vastness, and remoteness of Canada's northlands and inadequacy of scientific knowledge about them. The implications of this had a significant impact upon the method by which site proposals were brought forth. Most proposals were made by government and academic scientists who had a wealth of northern research experience and who collectively represented the strongest group of northern scientists available at the time. These people, based on personal research experience, proposed areas which they felt worthy of protection because of either their unique attributes or because they were worthy of protection as representative areas.

Those areas proposed because of their unique attributes can be assumed to be worthy of protection immediately, before they are negatively altered. The representative area proposals were seen as open to replacement by alternate areas if better representative sites were located. Concern was expressed that those sites selected for attributes representative of Canada's northern ecosystems should not be modified until after better or equally acceptable areas were proposed. Such an approach to the representative area proposals was found desirable to allow for either the upgrading of proposals or to allow swapping if resources worthy of extraction were found in the initially proposed site. The Sub-arctic IBP panel recognized the negotiability of these proposals and did not wish to impede development of the Canadian northland if nothing significant from a conservation viewpoint would be lost.

The Task Force again has taken a parallel position to the Sub-arctic IBP panel in this matter and has suggested under the section on protected area guidelines that: "where appropriate, alternative sites should be identified that might meet the specific conservation objectives; where comparable alternate sites exist, priority should be given to protected areas that have the lesser potential for conflict in resource use" (p.19).

Although the Task Force and Sub-arctic IBP panel are in agreement on the issue of representative areas, it is important that agencies involved in setting aside such areas not be lulled into a false sense of security and placed at a low priority level. To do such would be folly as representative areas are equally significant, though for different reasons than unique sites.

Has an adequate mechanism been recommended for the evaluation of proposed Ecological Areas prior to designation? The Task Force Report places a great emphasis on the question of evaluation of protected areas in general and Sub-arctic IBP proposed areas specifically. The task force, like the Sub-arctic IBP panel would ideally like to have evaluation based on objective criteria. However as the task force notes this is presently not possible.

> Annex A provides an illustration of the manner in which criteria be applied to selected protected areas. As noted in this annex, the subjective nature of the judgements about individual selection criteria is acceptable to the Task Force only because there is no obvious alternative. We believe, however, that the shortcomings inherent in such a subjective approach are offset to a considerable extent by the opportunity that would be provided through public hearings and other means to take account of the views of northern residents, resource managers and technical specialists (p. 18)

In Annex A, the Task Force suggests a three-step process for the selection and evaluation of proposed protected areas:

STEP 1 - SELECTION CRITERIA. To be considered as a protected area, a site must satisfy one or more of several selection criteria. The seven selection criteria proposed conform more or less to the cultural heritage and natural environment categories for protected areas discussed earlier in the paper.

STEP 2 - EVALUATION CRITERIA. If there is more than one proposal to designate a protected area that would be representative of a given region or ecological zone, then the selection of the best area from among the candidate proposals may require the use of other, more detailed evaluation criteria.

STEP 3 - PROTECTED AREA GUIDELINES. If a proposed site meets one or more of the specific selection criteria, certain guidelines should be followed for the designation and management of the selected protected areas (p.40).

Having put forth the above three evaluative steps the task force proceeds to evaluate each of the three steps using specific examples. The test evaluation presented by the Task Force (p. 41-42) is particularly instructive and serves to point out the difficulties involved for any decision-making body assigned the task of deciding which areas should be protected. Their conclusion pertaining to Step 1 is that it is a useful and essential component in the evaluation process despite the fact that it is extremely subjective. They accept this procedure partly because of expediency and the fact that no viable alternatives exist.

The task force conclusion regarding step two is that this step should be "rejected" because it is of no practical value for decision making "about protected areas" They conclude that Step 3 is important and practical from the perspective of land use planning decisions.

In reviewing the task force conclusions and recommendations, it would appear on the surface that the whole notion of using evaluation criteria in the selection of protected areas is of no particular value. On a closer examination this is clearly not the case. They conclude that this stage is essential when several areas are proposed for similar reasons although they suggested that such ranking of areas is best dealt with by the appropriate specialists who would make recommendations to those involved in land use planning. Methods have been proposed and developed by workers such as Bastedo *et al.* (1984) and Smith *et al.* (this volume). Clearly and unquestionably the use of evaluation criteria is of paramount importance to such specialists.

In evaluating the test example which the task force used to judge the merits of Step 2, a caution must be expressed. The task force chose 11 ecological sites proposed by the International Biological Programme panels as representative of the tree line region of the Northwest Territories, and listed their names and the total areas of each proposed site. If such a method were used, a planner or resource manager could well come to the conclusion that the smallest area should be chosen as all desired attributes are found in a very small area and would thus be the most expedient choice. Such logic would be nothing short of disastrous to conservation goals for it would be made on the false assumption of equivalence of attributes in all areas of the northern tree line. Canada's northern tree line is several thousand miles in extent and shows immense ecological variation from east to west. Hence the notion of equivalence among all proposals for protection of representative areas of the northern tree line are based, from the point of view of formal logic, upon a false term and as such the third term of the argument must also be false. A great deal of the discussion pertaining to the selection of representative areas is based upon the assumption that there is only one best representative area and that is the one that must be found and protected. The basis of this discussion must be questioned in light of the vagaries of nature. If only one area is protected and that site is destroyed there may be no alternative areas remaining. Although this argument may not hold now, it may well hold in the long term when the north is more fully settled. In support of this argument we need only look to the problems in finding good examples of native grassland in the Canadian prairies - these have been altered extensively by man's use to the point that Parks Canada has experienced great difficulty in finding suitable areas for such a park.

In all areas of conservation we must err on the side of the conservative and safe, keeping as many options open for the future as is possible and reasonable.

In evaluating the task force's response to the whole question of implementation two approaches seem possible, neither of which would be particularly useful or instructive;

1. evaluate the proposed implementation mechanism from the perspective of a general analysis,

2. evaluate it form a very detailed perspective.

To take the first approach would, I believe, indicate an overly capricious attitude on my part; an over simplification of a very complex process.

To take the second approach, that of a detailed evaluation, would far exceed my knowledge and capabilities or those of any other single individual and would accomplish little more than adding further confusion to an issue that a substantial and well rounded task force has dedicated a great deal of thought.

In order not to abrogate my responsibilities of evaluating this very important component of the Task Force Report on Northern Conservation this section of my evaluation will address the realm of perceptions on the appropriateness of mechanism suggested. Such perceptions reflect in no way a detailed personal analysis of the various mechanisms and procedures, political or otherwise, which must be developed in order to implement the task force recommendations.

1. On page 27 of the report the task force notes that the land-use planning process, when fully operational can form an important mechanism in the implementation of a northern conservation strategy. My perception of this statement is that it is exceedingly reasonable however I share the concerns of the task force with respect to the length of time it has taken to implement this process.

2. The task force notes that the absence of a functional mechanism is to implement a conservation strategy will result in continuation of the present make-shift resource management process that frustrates development plans and places areas in need of protection at risk. The report goes on to urge that an interim mechanism be adopted to make decisions until a fully operation land-use planning process is in place. With some appreciation of the major complexities and time required to formalize and implement major policies and strategies, particularly when they involve several different governments with many relevant departments in each, the suggestion of an interim mechanism appears to be both a reasonable and pragmatic approach to the problem.

3. The interim mechanism conceived as appropriate is an "Conservation Advisory Board" comprised of twelve members to be drawn from a wide area of interest and experience. The role suggested for such a board is both interim and long term. In the interim, the role would be to aid in the implementation of task force recommendations, to facilitate the establishment of a system of protected areas and early designation of key areas, and to provide advice to appropriate legislative authorities on land withdrawals pending possible designation as protected areas until the land-use planning authority is in place and fully operational.

   The conceived long term role is to provide the public with a forum on broad matters of northern conservation and strategy and provide ministers with ongoing advice pertaining to northern conservation and strategy.

   The notion of such an advisory board seems reasonable as do the suggested functions of such a board. It must be noted that such a board is strictly advisory and its ability to accomplish anything substantial is directly correlated to the commitment of the government to northern conservation. Such a board would have a very positive side in that it would have the political authority to exist and as such would function, at minimum, as a single agency to be approached by interested parties rather than the present situation where multiple players must be contacted independently.

4. From the perspective of institutional arrangements, the task force has made two very significant suggestions:

   a. establishment of a Cabinet Committee made up of those federal ministers having a responsibility for northern natural resources to ensure a common federal response to conservation issues;

   b. consolidation of all territorial government responsibilities for administering and managing land and other natural resources within one department of each of the territorial governments to ensure a common territorial response to conservation issues.(p.38).

I can not comment on the practicality of such an arrangement, however if it were implemented and functioned as intended, it would be of great benefit. At present when information is sought from any relevant departments of the three governments involved in northern conservation, continuity of responses is a rare event.

5. The final point on the proposed mechanism that I wish to allude to pertains to legal requirements. The task force has recommended that legislation should be modified to provide a conservation/management frame of reference and to reduce or eliminate existing or potential conflict or duplication. The task force further recommended that legislation should be enacted to fill present legislative gaps.

   It has been my experience when discussing conservation with federal and territorial officials and other knowledgeable individuals, that there is a general consensus that present legislation is woefully inadequate in providing for the management of entire ecosystems (Revel,1981). It is noteworthy that most provinces in Canada have seen fit, in their wisdom, to enact separate legislation to accommodate ecological reserves or equivalent areas. Perhaps this fact should be instructive to the three governments involved in conservation/preservation of northern Canada.

Conclusion

In conclusion, aside from a few significant reservations about the way in which the Task Force on Northern Conservation has dealt with their task, from the perspective of Sub-arctic International Biological Program, it is a commendable document which provides much sound advice and direction to all governments or agencies with interests in northern conservation and development.

If the north is to be developed with forethought and planning, and if economic development and conservation are to proceed, uncertainties must be removed by a quick action by federal and territorial governments.

The federal government, by virtue of striking the Task Force on Northern Conservation, has initiated some significant momentum on the issue of northern conservation and development.

Without the political will and commitment of the Federal Government of Canada, the Yukon Territorial Government and the Government of the Northwest Territories to continue this momentum on the implementation stage, the Task Force on Northern Conservation will have been for naught.

Task forces do not implement government policy, only governments can do that.

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An ACUNS commentary on the work of the Task Force on Northern Conservation is included in the Appendix.

The Role, Identification, Designation and Implementation of Environmentally Significant Areas in the Northwest Territories[1]

Paul G.R. Smith
J. Gordon Nelson
John B. Theberge

The Development of Comprehensive Approaches to Protected Areas

Publication of the World Conservation Strategy (IUCN 1980) focussed attention on the interdependence between conservation and sustainable development and the need for comprehensive systems of protected areas. Research into the basis for developing such systems recently has been intensive in a number of areas.

Criteria and techniques for identifying sites for conservation have evolved rapidly in the last ten years (Ploeg and Vlijm, 1978; Margules and Usher, 1981; Goldsmith, 1983; Roome, 1984; Smith and Theberge in press). Refinements have focussed on linking assessment of significance to sound ecological theory and better use of resource inventory information. The result has been increased clarity and precision in the use of concepts such as rarity and diversity, as well as technical advances in their application. These innovations in conservation evaluation, for the most part have concentrated on abiotic and biotic heritage, seldom considering cultural heritage and sometimes ignoring planning and management issues.

Considerable research also has been directed toward defining a series of internationally accepted categories of protected areas, criteria for the selection of each type, and objectives for management in each category (Miller, 1978; IUCN, 1978,, 1984). In particular, the IUCN document "Categories, objectives and criteria for protected areas" has been useful both to evaluate the adequacy of existing legislation and to decide on the most appropriate management category for particular areas (Dingwall, 1984; Mosley, 1984; Salm and Clark, 1984).

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[1] An earlier, briefer version of this paper has been published in *Environments*, 17(3), 1985, pp. 91-110.

Increasingly, the design of particular systems of protected areas draws on this growing body of knowledge. Several examples of comprehensive approaches to protected areas will provide examples of this, as well as some perspective on the methodology presented here.

The National Conservation Plan for Indonesia makes extensive use of detailed empirical natural history and biogeographic information as well as ecological theory, in identifying areas. This information is linked to management through a series of six types of protected areas designed explicitly to meet different conservation objectives. Linking includes consideration of needs for local use and development. The human values underlying protected areas are explicitly stated, including the goal of sustainable development. Protected areas are also related to broader conservation goals in population, agriculture, forestry and energy. The implementation of this plan is directed by one agency, the Directorate of Nature Conservation (MacKinnon, 2981; Sumardja *et al.*, 1984).

Quite a different example is the cooperative project of the governments of the Nordic countries to conserve "Representative types of nature in the Nordic countries" (Nordic Council of Ministers, 1983; Pahlsson, 1984). That project focussed on identification criteria, landscape and vegetation classification schemes, and compilation of ecological information on which to base planning decisions. Sophisticated, computer-based methods of data storage and processing were developed to use the compiled information. One of the strengths of the project lies in the comprehensive data collection and the ease with which it may be used in land use planning.

Probably the most comprehensive synthesis to date on protected areas planning is the recently published *Protected Areas: A Guide for Planners and Managers* (Salm and Clark, 1984). Salm brings together natural history and conservation biology with management concerns such as legislation, implementation, enforcement, public involvement and systems and management planning. A particularly innovative aspect of that work is linking IUCN management categories to site identification criteria by means of the objectives of each management category.

These three examples illustrate some elements of comprehensive approaches to protected areas, many of which are found in the method presented here. In terms of implementation, there is a key similarity in the three examples and our method. In each case, some means of coordinating the efforts of different agencies is used or promoted. A single agency is responsible for implementing the Indonesian National Conservation Plan. Ongoing cooperative agreements between the Nordic countries are the basis for the "Representative types of nature in the Nordic countries" project. Salm and Clark (1984) recommend that either a single agency or some cooperative arrangement, with sufficient allocation of resources, be responsible for protected areas programs. Similarly, Nelson and Jessen (1984) and the Task Force on Northern Conservation (1984) both recommend some coordinating body such as a heritage board or conservation advisory board to implement comprehensive planning of environmentally significant areas (ESAs) in the Northwest Territories (NWT).

The Role of ESAs in the NWT and Problems with their Management

In the Northwest Territories during the past two decades many areas have been identified as having special ecologic, geomorphic, biologic, archaeologic or other qualities. Examples include, 122 International Biological Programme (IBP) areas, six to ten potential national parks, as well as proposed national wildlife areas and territorial parks scattered throughout the more than three million square kilometres of land and water composing the territory. In spite of many proposals and recommendations, relatively little action has been taken to commit or designate areas for long term management appropriate to their special qualities. It is true that IBP areas have been flagged under the Territorial Land Use Regulations but such management does not adequately cover the needs of many IBP or other special areas and is rather fragile, being based in practice and not in law.

Why should people be concerned about such slow action in regard to areas with special geologic, biologic, archaeologic, or other qualities? Basically because these areas are the foci of natural and cultural features and processes–or functions–which are important to ecosystems, economies, and societies in surrounding and even very distant lands. As a result of such considerations we call these lands with special qualities, Environmentally Significant Areas, or ESAs. Others have termed them special places, conservation lands, or natural and cultural heritage areas. The proper identification, delimitation, and management of these lands, therefore, should be a first step in any comprehensive land use planning program in the NWT.

Different approaches to conservation are appropriate to different types of areas. Figure 1 is an attempt to make this point in graphic form and to show how preservation, protection, multiple use, and extractive use are related to recreation, tourism, hunting, and other types of land use as well as to national parks, national wildlife areas, and other types of management (Bastedo et al., 1984). Thus preservation, protection, and multiple use management strategies should be applied where appropriate to allow uses which can occur without threatening the environmental qualities for which an area is important.

Why have more ESAs not been delimited and designated for protection, use, and management in accord with their special qualities? For one thing their basic importance to ecosystems, economy, and society has not

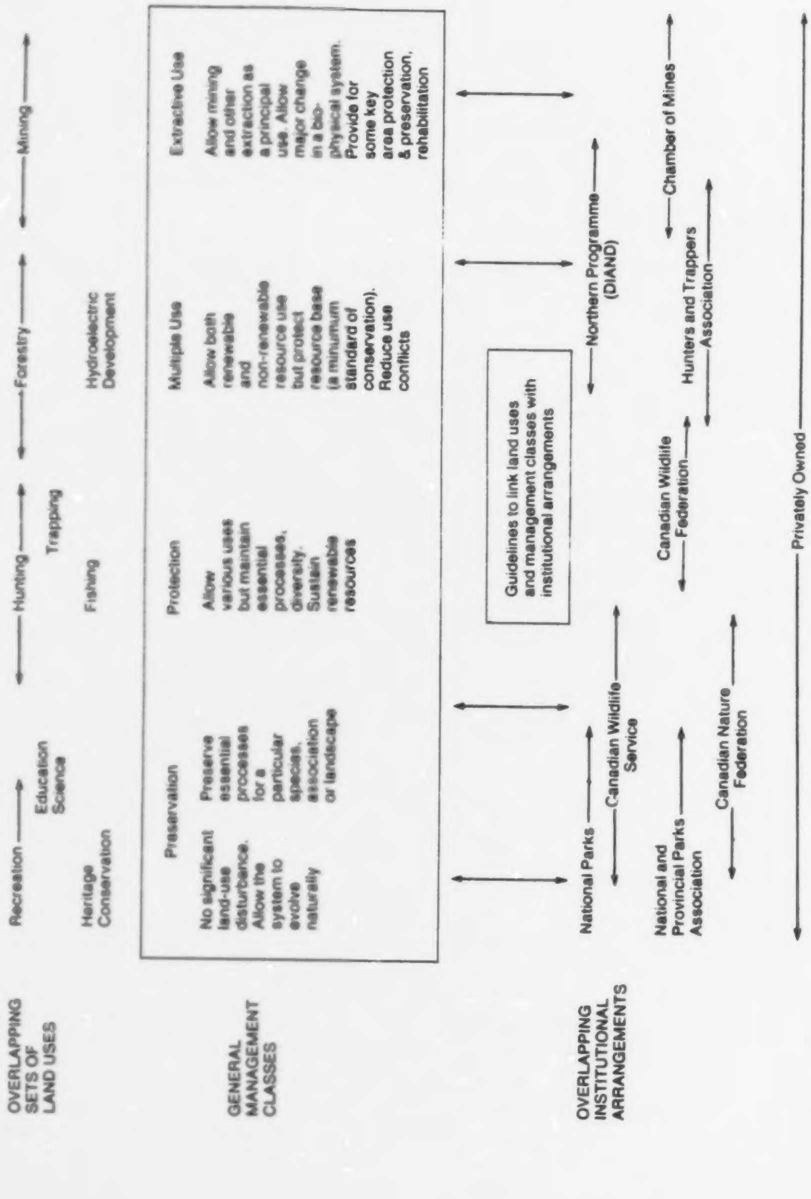
OVERLAPPING SETS OF LAND USES
Recreation
Education
Science
Heritage Conservation
Hunting
Trapping
Fishing
Forestry
Hydroelectric Development
Mining
GENERAL MANAGEMENT CLASSES
Preservation
No significant land-use disturbance. Allow the system to evolve naturally
Preserve essential processes for a particular species, association or landscape
Protection
Allow various uses but maintain essential processes, diversity. Sustain renewable resources
Multiple Use
Allow both renewable and non-renewable resource use but protect resource base (a minumum standard of conservation). Reduce use conflicts
Extractive Use
Allow mining and other extraction as a principal use. Allow major change in a bio-physical system. Provide for some key area protection & preservation, rehabilitation
Guidelines to link land uses and management classes with institutional arrangements
OVERLAPPING INSTITUTIONAL ARRANGEMENTS
National Parks
Canadian Wildlife Service
Northern Programme (DIAND)
National and Provincial Parks Association
Canadian Wildlife Federation
Chamber of Mines
Canadian Nature Federation
Hunters and Trappers Association
Privately Owned

Figure 1 *Balanced Land Use*

been sufficiently recognized, at least in the sense described above. Other obstacles in the NWT include competition for lands among native people, petroleum, mining, and other industrial enterprises, and federal and territorial government departments.

Contributing to conflict and disagreement is uncertainty over the natural and cultural character and significance of ESAs. These areas have often been described and mapped by different people in different ways. A general idea of their special qualities is frequently all that is available. Also, information may be incomplete or not well organized in reports on various ESAs.

Figure 2 of proposed conservation lands in the eastern Beaufort, illustrates the problems of deciding which areas are significant and why, as well as what agencies should manage particular areas and under what legislation or policy. IBP, Parks Canada and the Canadian Wildlife Service reports have drawn boundaries around these areas using different information and to achieve different objectives. Furthermore, other agencies have interests in and responsibilities for the areas shown in Figure 2. Inuvialuit agencies, as owners of a large portion of the region, have a strong interest in the use and conservation of these ESAs. Territorial agencies have a role in the management of these areas, particularly the NWT Wildlife Service with its mandate to manage the raptors and mammals for which many of the ESAs in Figure 2 are significant.

In sum, as a result of obstacles like the foregoing, a "logjam" exists, with many ESAs having been identified but few selected for appropriate long term protection, use and management.

In, 1982, this "logjam" became a serious concern for many interested persons in government and the private sector. Department of Indian and Northern Affairs produced a working paper highlighting many of the problems, and subsequently held a workshop on conservation in the north which resulted in a Task Force on Northern Conservation being established (DIAND, 1982; Banff Centre, 1983). The task force reported in December,, 1984 (Task Force on Northern Conservation, 1984). It strongly supported the formal designation and management of ESAs and recommended that an interim coordinating committee be formed to get cooperative work underway. The Task Force also proposed a system for describing candidate ESAs and deciding upon appropriate forms of management. While this system is a useful one, it does not have some of the key elements needed to break the "logjam" and permit allocation of ESAs among different types of appropriate management and tenure.

The basic purpose of this paper is to present an ESA planning process that has the elements needed to begin progressive ESA planning and allocation. The planning process is applied to seven proposed ESA in a sample area, the eastern Beaufort Sea region (Figure 2). The region contains the seven candidate ESA noted previously which are associated with can-

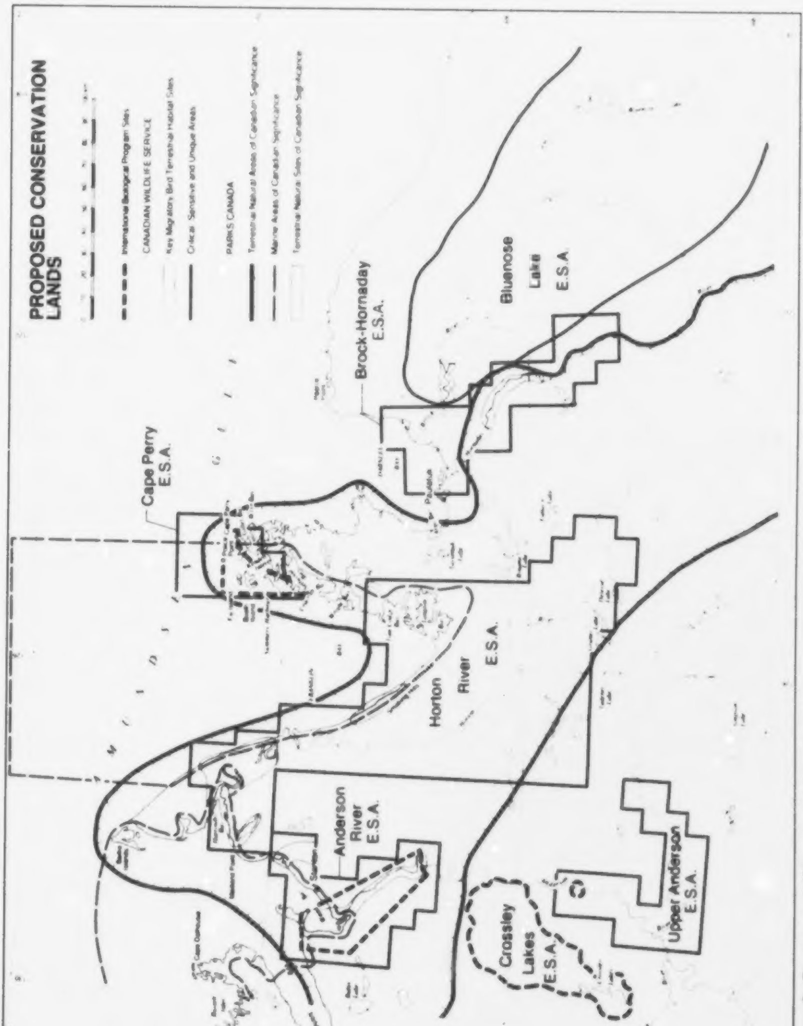
PROPOSED CONSERVATION LANDS
International Biological Program Sites
CANADIAN WILDLIFE SERVICE
Key Migratory Bird Terrestrial Habitat Sites
Critical, Sensitive and Unique Areas
PARKS CANADA
Terrestrial Natural Areas of Canadian Significance
Marine Areas of Canadian Significance
Terrestrial Natural Sites of Canadian Significance
Cape Perry E.S.A.
Brock-Hornaday E.S.A.
Bluenose Lake E.S.A.
Horton River E.S.A.
Anderson River E.S.A.
Crossley Lakes E.S.A.
Upper Anderson E.S.A.
Paulatuk

Figure 2 Proposed Conservation Lands

yons, nesting sites, calving areas, and other abiotic and biotic features summarized later. The eastern Beaufort region is about 30,000 km^2 and supports a light population of a few hundred people as well as other users from adjoining areas. Current uses are primarily hunting, fishing, and trapping and hydro-carbon exploration and related activities.

Three Basic Questions

Three key questions are addressed in this paper in order to reduce conflict and gain support for ESAs.

1. How to identify, describe and evaluate ESAs in terms generally acceptable to all interest groups; important here is the validity of the concepts, terminology, or criteria to be used.
2. How to decide on management or institutional arrangements for ESAs, i.e. the appropriate laws, agencies, and other processes to use in planning and managing each ESA.
3. How to priorize ESAs so as to assist in allocating limited planning and management staff and funds and make steady progress in designating ESAs.

How to Identify, Describe and Evaluate ESAs in Generally Acceptable Terms

Biotic and Abiotic Description and Evaluation

Many concepts, terms or criteria, have been used in different parts of the world to identify, describe and evaluate the significance of ESAs. Many of these criteria vary in precision and consistency of meaning but should be based on theory and practice in the natural sciences. Fragility for example, is an abstract concept with many meanings, whereas rarity can be defined in more precise terms. Smith (1984) critically examined the meaning and general usefulness of criteria and recommended that the seven shown in Table 1 be employed consistently in evaluating ESAs in the NWT. The seven criteria were used to describe and evaluate the significance of proposed ESAs in the eastern Beaufort and also as a basis for adjusting boundaries to include additional areas of high significance or exclude areas of low significance.

It is important to note that the application of these criteria in the eastern Beaufort area did not involve any field visits, direct acquisition of new

Table 1: Criteria for an Evaluation System for ESAs in the NWT

Criterion	**Method of Evaluation**
Importance for Wildlife	- the ESA is consistently used by a significant percentage of a wildlife population for a particular function
Rare Plant Species	- the ESA has a concentration of Rare Plant Species Types of Rarity: - Rare and Endemic - National - Territorial - Peripheral and Disjunct - National - Territorial
Rare Animal Species	- the ESA supports Rare Animal Species Types of Rarity: - Endangered and Threatened - Rare - National - Territorial - Peripheral and Disjunct - National - Territorial
Unusual Abiotic Features	- the ESA contains one or more significant unusual abiotic features
Abiotic Representativeness	- the ESA contains many representative abiotic features
Ecoregion Representativeness	- the ESA best represents the characteristics of an ecoregion
Diversity	- the ESA contains: - large numbers of Animal Species - large numbers of Plant Taxa

data on ESAs or consultations with local people. Rather, information on ESAs in the eastern Beaufort was compiled from existing surveys by Parks Canada, IBP, and other sources. Our method therefore served as a means of screening and ordering existing information. To help organize these data we developed a computer-based data bank of ESA information which could also be useful for other management purposes. What follows is a description of each of our criteria as noted in Table 1.

Abiotic and Biotic Criteria.

To assess each ESA's importance for wildlife we considered only those species and habitats which can be effectively managed in ESAs, such as seabird nesting colonies and caribou calving areas. For each of these, an area's importance to a particular wildlife population was assessed through a review of existing information. This assessment was sometimes a quantitative process, for example the Horton ESA has supported up to 8% of the known nesting sites of the world's population of the tundrius peregrine falcon. In other cases the information is more qualitative.

The rarity of biota in ESAs must be assessed with reference to a standardized list of rare species. An existing list of rare plants for the continental NWT (Cody, 1979) was applied to eastern Beaufort ESAs as was a working list of rare, threatened and endangered birds and mammals of the NWT which we developed (Table 2).

Unusual or rare abiotic features cannot be evaluated in such a concise manner as rare biota, as no standardized list of such features seems possible. Evaluation must therefore be based on a review of existing literature on each type of feature. For example there are no other canyons in the NWT like the Brock and Hornaday which are carved out of Cretaceous and Devonian substrate into castellated pinnacles and other unusual erosional landforms (Table 2).

Assessing an ESA's abiotic representativeness requires reference to a classification of representative abiotic features and a review of their occurrence throughout the NWT. A general classification was prepared for the eastern Beaufort, and linked with a review of the literature showed, for example, that the Horton ESA contains many representative abiotic features (Table 2).

Selection of a series of ESAs most representative of NWT ecoregions is a basis for conserving examples of the major landscapes of the territory. Evaluation of ecoregion representativeness depends on the mapping of ecoregions and a list of features which characterize each ecoregion. Using such a framework, the Crossley Lakes ESA was assessed as best representing the high sub-arctic ecoregion (Table 2, Figure 3).

ESAs with high diversity are assessed as those with a larger number of animal and/or plant species than expected for their size or area (Smith

Table 2 Summary of the Significance of the Seven ESAs

Criterion	Upper Anderson 1*	Crossley Lakes 2	Anderson River 3	Horton River 4	Cape Parry 5	Brock-Hornaday 6	Bluenose Lake 7
Biotic and Abiotic Criteria							
Importance for Wildlife	Territorial Significance (Peregrine)		National Significance (Snow Goose, Brant, White-fronted Goose)	National Significance (Caribou, Snow Goose, Peregrine)	National Significance (Thick-billed Murre, Common & King Eiders)	National Significance (Peregrine)	National Significance (Caribou)
			Territorial Significance (Barrenground Grizzly)	Territorial Significance (Barrenground Grizzly	Territorial Significance (Black Guillemot)		
Rare Animal Species	National Significance		National Significance	National Significance	National Significance	National Significance	
Rare Plant Species				High			
Unusual Abiotic Features				National Significance		National Significance	
Abiotic Representativeness				High			
Ecoregion Representativeness		High					
Biotic Diversity			High				
Cultural Criteria							
Symbolic Importance				High		High	
Historic and Archaeological Importance	Potential		Potential	Potential	Potential		
Importance to Native People				High	High	High	

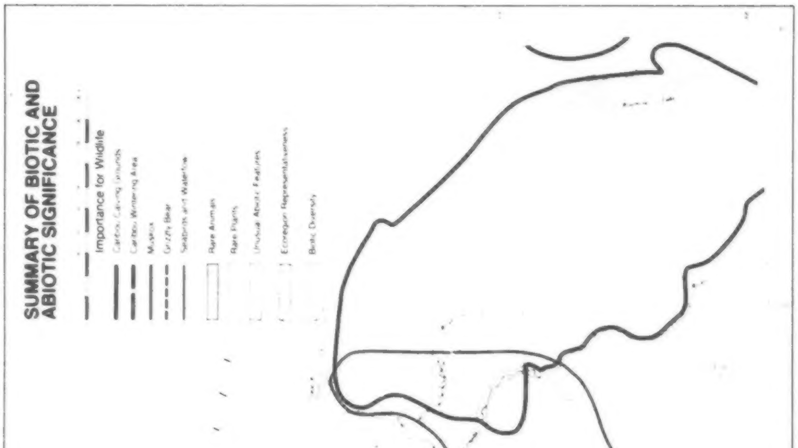

Figure 3 Summary of Biotic and Abiotic Significance

and Theberge, 1986). The expected diversity is estimated using regression techniques. This method revealed, for example, that the Anderson River ESA supports many more plant and animal species than expected for its size (Figure 3, Table 2).

No attempt is made to blend assessments of all criteria into an index of overall significance because such an index would have little ecological meaning. Criteria such as rarity and diversity are, like " apples" and "oranges", qualitatively different and cannot be added or reduced to one quantity. However, tabular and mapped summaries of abiotic and biotic significance are presented in Table 2 and Figure 3.

Cultural Description and Evaluation

In mapping and analyzing land use and associated cultural information, we used what has been termed the ABC resource survey and analysis method (Bastedo et al., 1984). This method was originally developed for use in describing and planning for individual ESAs in the Yukon. Although abiotic and biotic aspects of this method have not been used in describing and comparing the seven ESAs within the eastern Beaufort Sea region, the cultural component of the method has been quite valuable at this systems level of planning. The cultural component is useful in identifying and describing areas of cultural significance to be included in ESAs and in identifying land use conflicts or constraints.

In the case of the eastern Beaufort, two basic types of cultural or land use maps were prepared: level one, structural and functional maps, and level two, significance and constraint maps. The structural maps basically are "line and dot" and show settlements or other artifacts of various land uses.

Clearly it is possible to develop a very large number of structural maps, i.e. maps for each of type of use or cultural process. However, in the interests of economy and focus, a relatively small number of uses or processes are generally selected for initial analysis, on the basis of criteria such as historic significance, duration, extent, environmental effects, and heritage value. Figure 4 for example, shows the pattern of land tenure and different land management designations in the eastern Beaufort area.

Functional maps are a means of grouping the "lines" and "dots" representing the various land uses into patterns that are important to planners. The general types of patterns which are mapped are nodes, corridors and hinterlands. As their names imply, the nodes and corridors group activities which are relatively complex and interactive. They, therefore deserve careful attention from planners and concerned persons.

The constraint areas shown on Figure 5 represent an evaluation of structural and functional maps. They are portrayed in terms of conflict, tension, and compatibility zones. The distinction between conflict and ten-

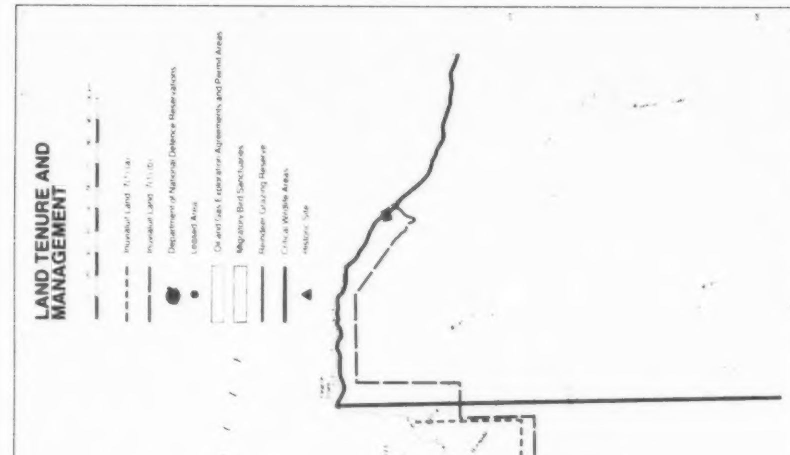
LAND TENURE AND MANAGEMENT
Inuvialuit Land 7(1)(a)
Inuvialuit Land 7(1)(b)
Department of National Defence Reservations
Leased Area
Oil and Gas Exploration Agreements and Permit Areas
Migratory Bird Sanctuaries
Reindeer Grazing Reserve
Critical Wildlife Areas
Historic Site

Figure 4 Land Tenure and Management

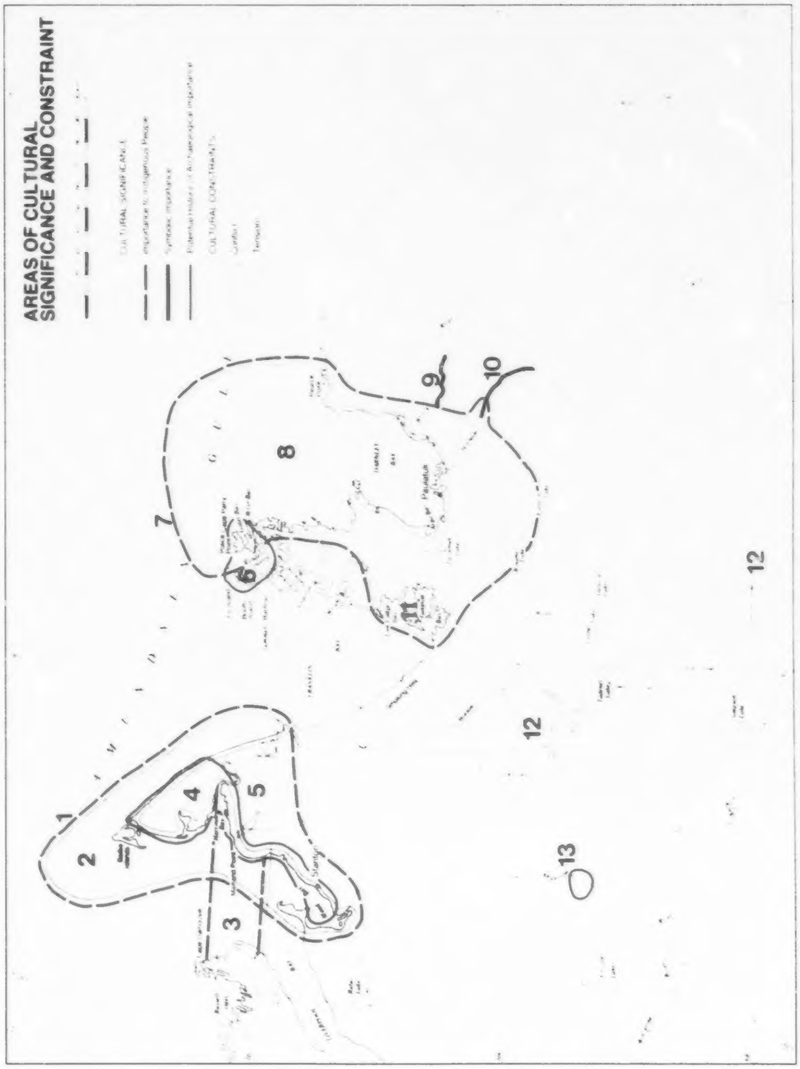
AREAS OF CULTURAL SIGNIFICANCE AND CONSTRAINT
CULTURAL SIGNIFICANCE
Importance to Indigenous People
Symbolic importance
Potential historic or Archaeological importance
CULTURAL CONSTRAINTS
Conflict
Tension
1
2
3
4
5
6
7
8
9
10
11
12
12
13

Figure 5 Areas of Cultural Significance and Constraint

sion zones is rather arbitrary and involves judgements based on number of land uses in an area, changes in land use, population growth, type of technology, and other factors.

Cultural Criteria

No serious attempt has been made to compile a detailed set of themes or concepts relating to northern prehistoric or historic phases and assign importance to them in terms of rarity, representativeness, importance to native people, or other criteria. In assessing the information on archaeological, historic, or other sites possibly meriting ESA status we therefore developed four relatively simple criteria: symbolic, historic, and archaeological importance, and importance to native peoples (Hans Bastedo, 1983). Assessments of the importance of sites were made rather arbitrarily by consensus and are presented in Table 2 and Figure 5. Although crude, the four criteria do generally organize the sites for planning. Work is needed however, to develop a more detailed set of criteria for assessing the cultural significance of various sites in the NWT.

These structural, functional, significance, and constraints maps and analyses are all used in describing ESAs and making judgements about their management as is evident in later discussion and in Table 5.

How to Decide on Management or Institutional Arrangements for ESAs

All of the foregoing discussion relates to the first question of how to identify ESAs in terms generally acceptable to all interest groups; the second basic planning question is how to decide on suitable management or institutional arrangements for these ESAs? What laws, policies, agencies, national park, or other arrangements should be applied to each ESA and why?

In thinking about the reasons for choosing one type or management or another, two kinds of considerations are applicable. The first has to do with *the characteristics of the ESA as described in terms of the abiotic, biotic, and cultural criteria discussed previously.* What range of geologic, plant, animal, historic, archaeological, and other features and processes is the ESA important for? Is it only for one or two species or features, or for many? Perhaps it is a landscape representative of a natural region or ecoregion in the NWT? How significant are the various features, processes and landscapes? Are they important regionally, nationally, internationally? By answering such questions, by describing the ESA in these terms, we actually describe not just the characteristics, but the purposes of the ESA.

The second type of consideration has to do with the *characteristics of the laws, agencies, or other institutional arrangements that can be*

Existing and Proposed ESA Designations in the NWT

Table 3: Existing and Proposed ESA in the NWT

Existing ESA Designation	Proposed ESA Designation	Agency	Legislation or Policy	IUCN Management Category
National Park		Parks Canada	National Parks Act	National Park (II)
National Historic Park				
	National Landmark		Parks Canada Policy	National Landmark (III)
	National Marine Park		Draft Marine Parks Policy	National Park (II)
Historic Places		DIAND	Historic Sites and Monuments Act	
National Wildlife Area		Canadian Wildlife Service	Canada Wildlife Act	Wildlife Sanctuary (IV)
Migratory Bird Sanctuary			Migratory Birds Convention Act	Wildlife Sanctuary (IV)
	Fish & Marine Mammal Sanctuary	Dept of Fisheries & Oceans	Towards a fish habitat policy	Wildlife Sanctuary (IV)
	Ecological Reserve	DIAND	Comprehensive Conservation Policy & Strategy	?
Land Withdrawl		DIAND	Territorial Lands Act	Resource Reserve (VI)
Reservation		DIAND & NWT Water Board	Northern Inland Waters Act	Managed Resource Area(VIII)
Natural Environment Recreation Park		Parks & Tourism Division	Territorial Parks Ordinance	National Park (II)
Outdoor Recreation Park				Managed Resource Area(VIII)
Historic Park				
Wildlife Preserve		NWT Wildlife Service	Wildlife Ordinance	Wildlife Sanctuary (IV)
Wildlife Sanctuary				Wildlife Sanctuary (VI)
Critical Wildlife Area				Wildlife Sanctuary (VI)
Development Area		Local Gov-ernment	Dept of Development Ordinance	Area Managed Resource Area (VII) Protected Landscape (V)

applied to each ESA. The aim is to find an institutional or management arrangement which has the characteristics required to match the abiotic, biotic, and cultural characteristics, or purposes, of the ESA in question. The goal is to match the purposes of each ESA with a management type having appropriate characteristics and strengths.

The first step in finding appropriate ESA institutional arrangements is to compile an inventory and general description of the available array of laws, agencies, and management types. Table 3 is a list of the available ESA designations, agencies, legislation and policy in the NWT and the IUCN management category into which each ESA designation best fits. A detailed inventory of available types of ESA management is presented in Nelson and Jessen (1984), where the arrangements are described in terms of goals, agency, legislation, regulations, policies, reserves or special designations, permitted uses and other categories shown in Table 4.

This type of analysis is used to describe and highlight the strengths and weaknesses–or role–of available institutions in managing ESAs. This information can be used in judgements about matching laws, or agencies with one or more ESAs in an area such as the eastern Beaufort. The IUCN management categories provide an international standard which can be used to evaluate the adequacy of the existing types of ESA management. This information and these frameworks can thus be used to identify weaknesses or gaps in institutional arrangements and help deal with them.

Table 4 Frameworks for Agency and Legislative Analysis

Legislative Analysis	**Agency Analysis**
1. Legislation	1. Agency
2. Agency	2. Mandate
3. Purposes, Goals, and Objectives	3. Goals
4. ESA Designations	4. Ideology
5. Land Uses - Permitted - Not Permitted	5. Institutional Character
6. Tenure	6. Land Use Types and Activities
7. Management Procedures - Planning, Implementation, Enforcement	7. Institutional Comprehensiveness
8. Monitoring and Feedback	8. Land Access and Control
9. Policy Co-ordination	9. Experience and Image

The foregoing types of institutional analysis have been employed in our work. Some of the results are shown in Table 5 and Figure 6 where each ESA in the eastern Beaufort is assigned to a reserve or management type or a combination thereof. In every case the basis for the decision can be understood by examining the abiotic, biotic, and cultural characteristics of each ESA as these are described on Table 2 and matching these with the characteristics of the reserve types listed in Table 3 which are described in detail in Nelson and Jessen (1984) and Smith et al. (1985).

How to Priorize ESAs for Action

The third question to be addressed in this ESA planning process is how to establish priorities for ESA designation. Behind this question is the idea that planners and managers wish guidance on which candidate ESAs would be appropriate for relatively quick action, which are of longer term interest, and which require further information. In consequence four levels of priority are used: 1) short term priority; 2) medium to long term priority; 3) no action at this time; and 4) further information or research needed on an immediate or longer term basis.

As Table 5 indicates such priorities have been set for each ESA in our sample area, but only in the context of the proposed ESA management arrangement to which the ESA has been assigned. We have not found it possible to rank ESA's across or among institutional types on any technical basis. Such ranking is again an "apples" and "oranges" issue which involves value considerations and so citizen or political input.

In placing priority on the ESAs within each proposed ESA management arrangement, it has been found helpful to develop a set of criteria as a basis for judgement. These criteria are:, 1) the *significance* of the ESA, whether national, territorial, or otherwise and its relationship to the *responsibilities* of particular agencies; 2) *land use* threats and compatibilities in and near ESAs which frequently influence management decisions; 3) *ease of establishment* is based on the fit between an ESA and agency goals, citizen support, relative lack of interagency or industrial competition, and other factors; 4) *place in the system* refers to the role that an ESA can play in agency plans or in terms of the overall system of ESAs in the NWT; and 5) *social and economic benefits* are important, especially in times of constraint or in areas where employment, entrepreneurial or other gains can supplement ongoing or traditional activities. For example, the Horton and Brock-Hornaday ESAs offer particular opportunities to combine conservation with economic development through tourism and recreation (Table 5).

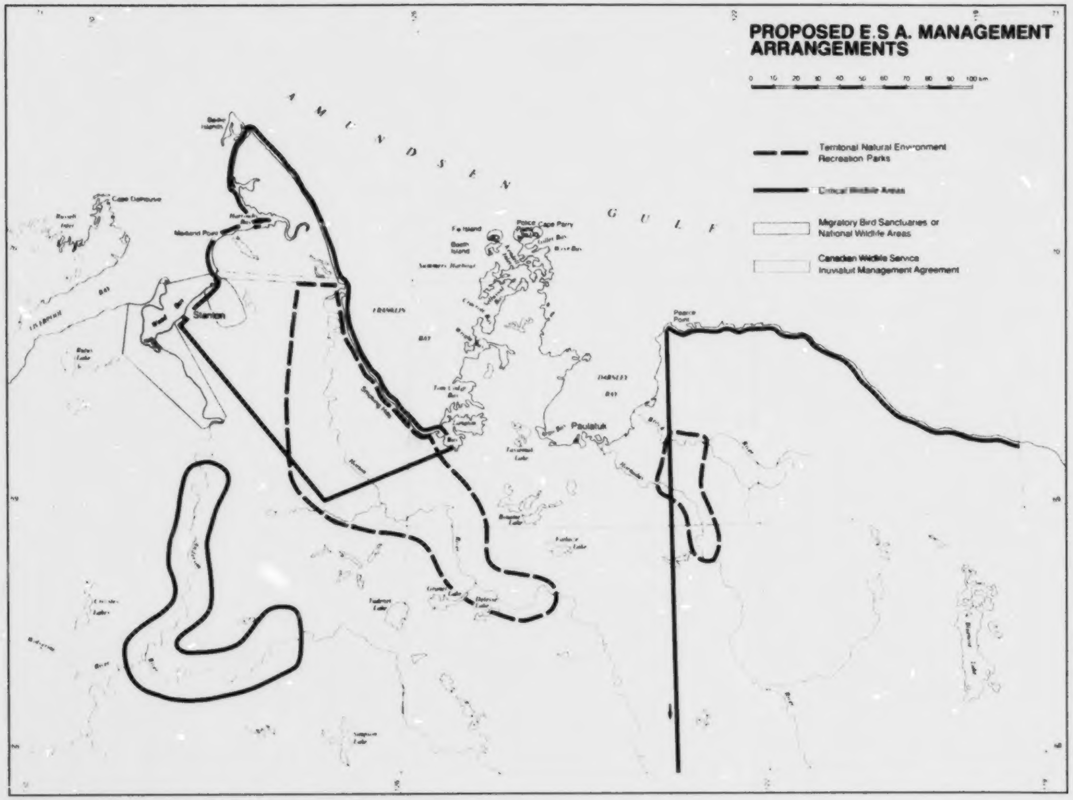
PROPOSED E.S.A. MANAGEMENT ARRANGEMENTS
0 10 20 30 40 50 60 70 80 90 100 km
Territorial Natural Environment Recreation Parks
Critical Wildlife Areas
Migratory Bird Sanctuaries or National Wildlife Areas
Canadian Wildlife Service Inuvialuit Management Agreement
AMUNDSEN GULF
Cape Dalhousie
Nicholson Point
Stanton
Fiji Island
Booth Island
Police Point
Cape Parry
FRANKLIN BAY
DARNLEY BAY
Paulatuk
Pearce Point
BAY

Figure 6 Proposed ESA Management Arrangements

Table 5 Priority Assigned to the Seven ESAs

	Upper Anderson	**Crossley Lakes**	**Anderson River**	**Horton River**	**Cape Parry**	**Brock-Hornaday**	**Bluenose Lake**
Recommended Management Arrangement	CWA or NWA	No good fit, private	NWA or MBS expanded	Inuvialuit-CWS Management Agreement and Territorial Park (NERP)	Expanded MBS or NWA or ADO	Territorial Park (NERP) or National Landmark	CWA or NWA
IUCN Management Class	Wildlife Sanctuary (IV)		Wildlife Sanctuary (IV)	Natural Monument (III)	Wildlife Sanctuary (IV)	Natural Monument (III)	Wildlife Sanctuary (IV)
General Type of ESA	Species-type: Birds	Representative landscape	Species-type: Birds	Multiple Values	Species-type: Birds	Geologic and Scenic	Species-type: Mammal
Significance	NWT-WS clearly responsible	No agency clearly responsible	CWS clearly responsible	Several agencies involved	CWS clearly responsible	Several agencies involved	NWT-WS clearly responsible
Land Use	generally compatible	a number of conflicts	some conflicts	possible conflicts	generally compatible	generally compatible	compatible
Ease of Establishment	relatively easy	difficult	some impediments to expansion at present	difficult to assess	little land involved; simple expansion	relatively easy	already exists; a change in management approach
Place in System	should be part of system of raptor areas	no agency link	important expansion	important addition	important expansion	important addition	already part of system
Social and Economic Benefits				high potential for tourism and recreation		high potential for tourism and recreation	secures a critical renewable resource
Planning and Management Priority	Immediate, short-term priority	No action needed at present	Medium to long-term priority	Immediate, short-term priority	Immediate, short-term priority	Immediate, short-term priority Medium to long-term information need for Brock Lagoon	Immediate, short-term priority

Abbreviations used in the Table: CWA, Critical Wildlife Area; NWA, National Wildlife Area; MBS, Migratory Bird Sanctuary; ADO, Development Area under the Area Development Ordinance; NERP, Natural Environment Recreation Park classification of Territorial Parks Ordinance; CWS, Canadian Wildlife Service; NWT-WS, Wildlife Service of the NWT government; IUCN, International Union for Conservation of Nature and Natural Resources.

Implementation

In conclusion we believe that if a planning process like the foregoing were followed, it could do much to break the ESA "logjam" in the NWT. We also believe that this system could be useful in other parts of Canada and the world.

One other ingredient is needed to make the system work in the NWT, a coordinating body of some kind. This body would bring the various government and private interest groups together to exchange information, arrange for technical analysis, and make or recommend upon value judgements.

Without such a coordinating body the interactions and dynamics needed to make progress would very likely not take place. Such a body would be especially important in early phases, in getting the system going.

Earlier we noted that the institutional analysis described herein could reveal weaknesses in an ESA planning and management system. Such has been the case in this eastern Beaufort study. Of significance in this regard is the lack of a consistently sound basis for designating IBP areas, for example an Ecological Sites act or ordinance of the type found in British Columbia or Quebec. Similarly, the national marine park and national landmark designations are, at present, only possible additions to the *National Parks Act*. With no marine park designation and no current ability by the Department of Fisheries and Oceans to designate ESAs, coastal and marine ESAs lack any effective management.

Recent federal government budget cuts have left the Canadian Wildlife Service, Parks Canada, and other northern programs with relatively little funding and manpower. Parks Canada now has only two planning and coordinating staff in its Northern office in Yellowknife. No Canadian Wildlife Service personnel seem to be responsible for national wildlife areas in the North. Indeed with the CWS now limited to managing species protected under the Migratory Bird Convention, the larger mandate provided in the *Canada Wildlife Act* may be abandoned in the north.

The NWT *Territorial Parks Ordinance* has a comprehensive series of five types of parks. Two of the three types of parks which could be used to manage ESAs have never been applied due to the reluctance of the federal government to transfer land to the GNWT. Even so, the Tourism and Parks Division of GNWT is preparing a parks strategy but currently only devotes approximately 3, 1/2 person-years to planning and developing territorial parks including the many wayside and community parks.

Territorial designations to protect wildlife and habitat under the *Wildlife Ordinance* are not strong, the current wildlife sanctuaries and preserves being vestiges of a dismantled system (Hunt, 1976), and the critical wildlife area designation having had no regulations promulgated to guide management. Nevertheless, the NWT Wildlife Service is reviewing areas of interest and means for their management under legislation and policy. One full-time and two contract positions in the NWT Wildlife Service are currently allocated to this task.

In sum, the ESA planning procedure described in this paper and summarized in Table 6. can be a useful means of addressing the ESA "logjam" but the institutions involved are currently weak overall and probably unable to implement this or any comparable management arrangement. The existing types of ESA management are largely "paper tigers" unless more resources are forthcoming to NWT agencies to perform the roles from which certain federal agencies seem to be withdrawing. The implications of this conclusion should be profoundly disturbing to all those concerned with appropriate use and protection of key natural and cultural resources in the NWT, not only for their own sake, but as a basis for sustainable development in the future.

Table 6 *ESA Planning Process*

1. Establish character, role, and importance of ESA in a comprehensive land use, resource or environmental management system.
2. Study the social, economic, technical and ecological context and identify obstacles to ESA development.
3. Identify main issues to be addressed to reduce conflict and gain support for ESA; stated generally the key questions are:
   a) how to identify ESA in terms generally acceptable to all interest groups, important here is the scientific validity of descriptive criteria;
   b) how to decide on an appropriate institutional framework for ESA, i.e. the appropriate laws, agencies, etc. to plan and manage each ESA;
   c) how to priorize ESA in order to make steady progress in establishing ESA.
4. Collection information on ESA proposals by different agencies and groups and do other inventory as funds permit.
5. Use scientifically or other acceptable criteria to describe ESA in common terms for comparative purposes.
6. Establish the regional, territorial, national or international significance of each ESA in terms of abiotic, biotic, and cultural features, using processes and criteria such as rarity, and diversity.

7. Review strengths and weaknesses - or role - of available laws, agencies, or other management arrangements in terms of consistent criteria, such as legal base, permitted uses, track record, budget, etc.; identify gaps in management system.
8. Link each ESA, its characteristics and significance as set forth in points 5 and 6 to an appropriate management or institutional type in terms of the criteria in point 7.
9. Set the priorities for the establishment of ESAs within each management type in terms of agreed upon criteria and advice of advisory groups or other bodies having a membership appropriate for making value judgements.
10. Recommend a means of implementing the coordinated planning and management inherent in this ESA planning system.

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Land Use Planning for Conservation

Lars Pahlsson

Introduction

Until now physical planning or land use planning has been mostly a technical process whereby areas are spaced for human uses. Society has stressed exploitation of land areas for housing and industries, sometimes surrounded by areas for recreation. Plans have also been made for the exploitation of minerals, stones and gravel. In a wider sense, land use planning has comprised farming and forestry activities but in that context the planning commonly has aimed also at the improvement of the economic outcome of the activities.

The development of land use planning during recent decades has given new points of view. Land use is no longer conceived as exploitation for farming, forestry and similar purposes. It has been realized that there is a need to consider the biological environment of all living species, including ourselves as well as ecological relationships within Nature and landscapes. New aims of land use planning have emerged.

- Land use planning must be conducted in a wider sense, comprising all forms of land use within the natural environment.
- New concepts of land use must be accepted. Modern society requires areas where the land use includes conservation, science, recreation and the like. These concepts must be treated on the same level as, for example, different forms of agricultural or forestry production. The possibilities of multiple use within an area always must be examined.
- The techniques of different types of land use must be adjusted to biological and ecological considerations.
- Land use planning must involve the use of biological and ecological knowledge.

The last point involves our knowledge of ecosystems. The ecosystem contains different biotic and abiotic structures working together in a functional relationship. Among factors influencing the ecosystem, land use may be considered as a complex of mechanical and chemical influences.

This connection between the ecosystem and the land use ought to be the base of all land use planning.

Classification of the Natural Environment

When analyzing the natural environment for planning, the main structures of the ecosystems must be known and classified: biological, geological and climatic structures but also structures of land use adjusted to their influence on ecosystems. These structures must also be identified as areas or components of landscape (Haber, 1980; Troll, 1968).

Mapping of vegetation types normally can be used to delimit areas covered by different ecosystems containing the whole complex of structures. Such area units have also been referred to as "ecotopes" (van der Maarel, 1977; Troll, 1968). Within the project of the Nordic Council of Ministers entitled "Representative Types of Nature in the Nordic Countries" the vegetation types of Norden have been classified (Nordic Council 1984b). Mainly based on the floristic pattern, each type has been delimited in such a way that it can be understood both by scientists and practical planners (with biological education) and used as indicators of ecotopes. Classification is also hierarchic (Figure 1).

The floristic base of the units makes it possible to consider the occurrence of interesting species. Such species may be both rare and endangered but also species of economic importance. The connection with the ecosystem concept gives way to analyses of functional aspects of alternative land use forms.

Another important factor, forming the main feature of the landscape, is the geomorphology. Landforms of the Nordic Countries have been classified in the same way as the vegetation types (Figure 2) (Nordic Council, 1984c). However difficulties have arisen in getting the same hierarchical order in geomorphic as in the vegetation types.

Classification of Land Use

As mentioned above, adequate concepts of present land use are an important tool for the planning of future land use. Among these concepts of land use we find relicts of earlier historical land use and also other historical components such as ancient graves, buildings, and so forth. This condition forms an important link between the planning of the natural environment and the management of the cultural heritage.

A working group of the Environmental Protection Board in Sweden has made a classification of land use concepts, considering them both as important factors influencing the ecosystem and as a linkage to the management of the cultural heritage. Thereby it has been evident that there is a need of principal differentiation within the concepts of land use. The following major groups of land use concepts are distinguished:

Cultural Landscape Component

Use of areas: Areas or surfaces with a defined usage for the withdrawal of biologically renewable (biological production) or non-renewable natural resources (water, minerals, oil, peat, etc).

Constructions or structures including ancient monuments: Landscape components without production of their own, commonly on limited areas.

Activity

Industrial undertakings and procedures connected to and influencing the cultural landscape components.

Technique

Special tools and methods used within the activity.

When analyzing features of land use within a landscape it is necessary to put together concepts for each of these groups. For instance, the area component "hay meadow" may be connected with different activities. The hay cutting may perhaps be combined with grazing or the use of the area as a ski-post during the winter. The hay cutting could be done with large harvesting machines but also with a simple scythe. Factors such as intensity and duration, including changes over the time (historical periods), must also be linked to these concepts. In that way an information base is obtained which can be used when evaluating the influences of land use on ecosystems. Finally, the description of the hay meadow area also includes the occurrence of barns, cairns, and similar features, linked with principle concepts of constructions or structures.

The Landscapes - Physical Geographical Regions

A landscape is characterized by its content of different natural and cultural components. A given combination of homogeneous components covering a certain area will constitute a defined landscape type. Such a landscape type can be delimited as a physical geographical region or - stressing the living components - a biogeographical region.

Using mainly the vegetation types and the land forms, but also climate and land use, Norden has been subdivided into 76 physical geographical regions (Figure 3). The characterizing natural features and landscape components of each region are described as well as diverging ones which are rare or unique (Nordic Council, 1984a).

Type Classification of Norden Vegetation Types

5. Vegetation of the cultivated landscape
5.1 Heath vegetation
5.1.1 Dwarf shrub heath

5.1.1.5 HEATHERCLAD HEATH (Calluna vulgaris)

Extension: Regions 1, 3, 4, 5, 7, 8, 10, (11), 15, 18, 21.

Area: Small (< 1000 ha).

General description

a) Physiognomy: Quite open dwarf shrub heath, sometimes with juniper bushes.
b) Soil conditions: Sandy - unsorted soils, luvisols.
c) Climate: Rather humid, mild winters.
d) Further characteristics: Normally Hairy Greenweed (Genista) is lacking. Cow-berry and bilberry (Vaccinium vitis idaea and Vaccinium myrtillus) very common.

Species:

Antennaria diuica
Arnica montana
Calluna vulgaris
Carex pilulifera
Deschampsia flexuosa
Galium saxatile
Juniperus communis
Potentilla erecta
Scorzonera humilis
Sieglingia documbens
Trientalis europaea
Vaccinium myrtillus
Vaccinium vitis-idaea
Dicranum rugosum
Hypnum cupressiforme
Pleurozium schreberi
Ptilidium ciliare

Figure 1 Record sheet of heatherclad heath from 'Vegetation types in the Nordic Countries.'

In this way about 600 vegetation types in Norden have been described. In order to better survey the material, it has been grouped according to alpine vegetation, forests, mires, sea shore vegetation, open grassland and heath vegetation and lake vegetation. The title of the vegetation type gives the main group, two complexes and the type name. This hierachial treatment also enables the subdivisions to be used in planning at different levels and with different aims.

Figure 1 (continued)

Number of species: 15-20 vascular plants, 5-10 mosses, 5-10 lichens (Cladonis).

Extension of species: Moderately southwestern species (Galium saxatile).

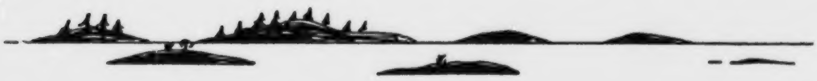
Stability, successions: Without grazing overgrowing with juniper and beech towards oakwood.

Landuse, management: Grazing, burning.

Changes of land use: Ceasing of grazing, wood plantation.

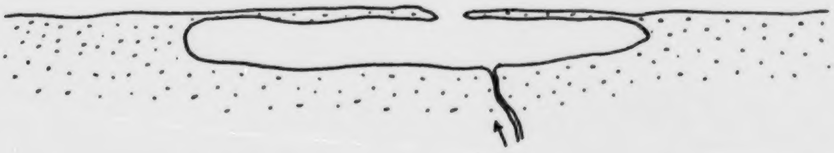
Value: Vegetation type with characteristic composition in southern Scandinavia, possibly with connections in Germany and Poland. Very small extension and strongly endangered. Needs protection and management.

References: Böcher 1940, 1943, Damman 1957, Gimingham 1961.



13 ARCHIPELAGO

Coast area with several larger and smaller islands, islets and skerries with interposed water. This type of landscape is most nicely developed in areas of archaic bedrock which earlier have been glaciated. The archipelago is often a continuation of hilly landscapes on higher levels beyond the coastal zone. Archipelagoes are found in several places in the Nordic countries, for example on the Swedish east and west coasts and along the Finnish southern and southwestern coasts. They are strongly characterized by tectonics and glacial sculptures.



3 Other landforms related to processes
3.5 Forms of coast and beach areas
3.5.2 Coastal forms in superficial deposits

3.5.2.7 BEACH LAGOON

Waves and currents transport material along the shore of the open shallow coast. On the lee of headlands or sudden indentations of the coastline the material is deposited. Here a spur is formed that grows in the direction of the windward shore. If the spur reaches the opposite shore of a bay, or if two converging spurs meet, a beach lagoon is formed, usually shallow. Such a lagoon can also be formed in conjunction with a double or more complex tombolo. Beach lagoons, into which waterways open, generally still have a link with the sea through the enveloping sandbank. In due course completely cutoff beach lagoons will be filled with fine sediment and will gradually fill up, whereupon they are converted into fens or become completely dried out. Examples of beach lagoons are found in Denmark, on the Falsterbo peninsula in Skane and at Billudden in northern Uppland.

Figure 2 Descriptions of land forms

Structural Evaluation of Nature for Planning-The Representativity Concept

Different criteria have been given for the consideration of structural conditions in nature when setting priorities for the conservation of natural types and areas (Helliwell, 1973; van der Maarel, 1977; Tjallingii, 1974; Westhoff, 1970). The criteria can be applied to any type of landscape components.

1. *Frequency and rarity* - the fewer occurrences and the smaller the total area the greater the value.
2. *Representativity* - typical or characteristic occurrences have greater value than others.
3. *Diversity* - the greater the diversity and variation the greater the value.
4. *Area/form* - many ecosystems require a certain area so that its nucleus is as far from the border as possible. Large and more or less circular areas are more valuable than others.
5. *Change* - areas that reflect either natural or cultural processes of change are valuable.
6. *Originality* - areas that have developed without cultural influence for many years and which contain ecosystems close to nature are valuable.

Among these criteria, representativity as an expression of the landscape's distinctive features is regarded as being particularly important. According to existing definitions of representativity, something that is representative must be placed in relation to something else. In evaluation of nature, nature types or other landscape components, these representative features, consequently must be related to some type of defined area. Such an area could be the physical geographical region (Udvardy, 1975; Yazan, 1983). The condition for judgement of the repesentativity of a landscape component will be the knowledge of the appearance and occurrence of this component within a region and in areas surrounding it. Detailed knowledge is required of:

- how the component or type or nature varies
- the areas within which the component or nature type occurs
- the frequency and pattern of these areas in the landscape or region

Figure 3

1 Western Jutland
2 The lake district of Jutland
3 Areas around the Limfjord
4 Himmerland-Djursland-N Zealand
5 Marine landscape of Vendsyssel
6 Plains of SE Denmark - SE Scania
7 Central Scania and Bornholm
8 Woodlands of NE Scania
9 Fissure valley landscape of Blekinge
10 The coastland of Halland
11 The western highlands of S Sweden
12 Plains of southeastern Småland
13 The highland of southern Sweden
14 Öland and Gotland
15 Coast areas of W Sweden and S Norway
16 The oak-region of Sörlandet
17 The pine-birch region of Sörlandet
18 Coast areas off the Oslo fjord
19 Mixed forests of southern Norway
20 The coniferous area of Östlandet
21 The hilly woodlands of SW Sweden/ E Norway
22 The central plains of Götaland
23 Woodlands of Northern Götaland
24 Fissure valley landscape of eastern Svealand
25 Coasts and archipelagoes of the Baltic Sea
26 Woodlands south of "limes"
27 Woodlands north of "limes"
28 Hilly lands of the S boreal region
29 Coastal plains of the Gulf of Bothnia
30 Hilly m. boreal woodlands
31 The cambro-silurian area of Jämtland
32 Coniferous woodlands of N Sweden and N Finland
33 Premontane region
34 Coniferous forests with birch N Dovre
35 Southern mountain (fjeld) area
36 Northern high mountain (fjeld) area
37 Forests of deciduous trees and pine in Vestlandet
38 The heath area of western Norway
39 Coastal area with woods in Möre and Tröndelag
40 Coastal area of Möre and Tröndelag
41 The lowland area of Tröndelag
42 The mountainous coast of Nordland
43 Birch and pine forests in Nordland
44 Birch and pine forests in Troms
45 Coastal area of northern Tromas
46 Coastal area of western Finnmark
47 Coastal area of eastern Finnmark
48 Area of birch and pine forests in Finnmark
49 Continental forests of Finnmark and Lapland
50 Birch and pine forests of Sör-Varanger
51 The pine forest area of Inari
52 Coniferous forests of N Lapland
53 Forest and mires of N Österbotten
54 The southern hilly vaara-region
55 The mire area of Suomenseklä
56 The interior of S Österbotten
57 The coast area of southern Österbotten
58 The lake district of Finland
59 The southern plains of Finland
60 The oak region of SW Finland
61 Reykjanesskagi-Snaefellsnes westernmost part; lava soils and undulating terrain
62 Esja-Borgarfjördur-Mýrar-Snaefellsnes "strandflaten" and valleys
63 Snaefellsnes-Dalir coastal area and highlands
64 Breidafjördur archipelago-"strandflaten" region
65 Vestfirdir fjords and highlands
66 Sudur-Strandir and Húnavatnssýsla valleys and heath regions
67 Inner highlands, northwestern parts
68 Valleys, fjords and plateaus of northern Iceland
69 Inner highlands, eastern parts
70 Plateau heaths and coastal regions of northeastern Iceland
71 Fjord and valley region of Östlandet
72 Breidamerkursandur-Skeidarár-sandur-Mýrdalssandur
73 Skaftafell-Fljótshverfi-Sida-Skaftártunga lowlands and heaths
74 Inner highlands, southern parts
75 Lowlands and agricultural region of southern Iceland
76 Glacial areas

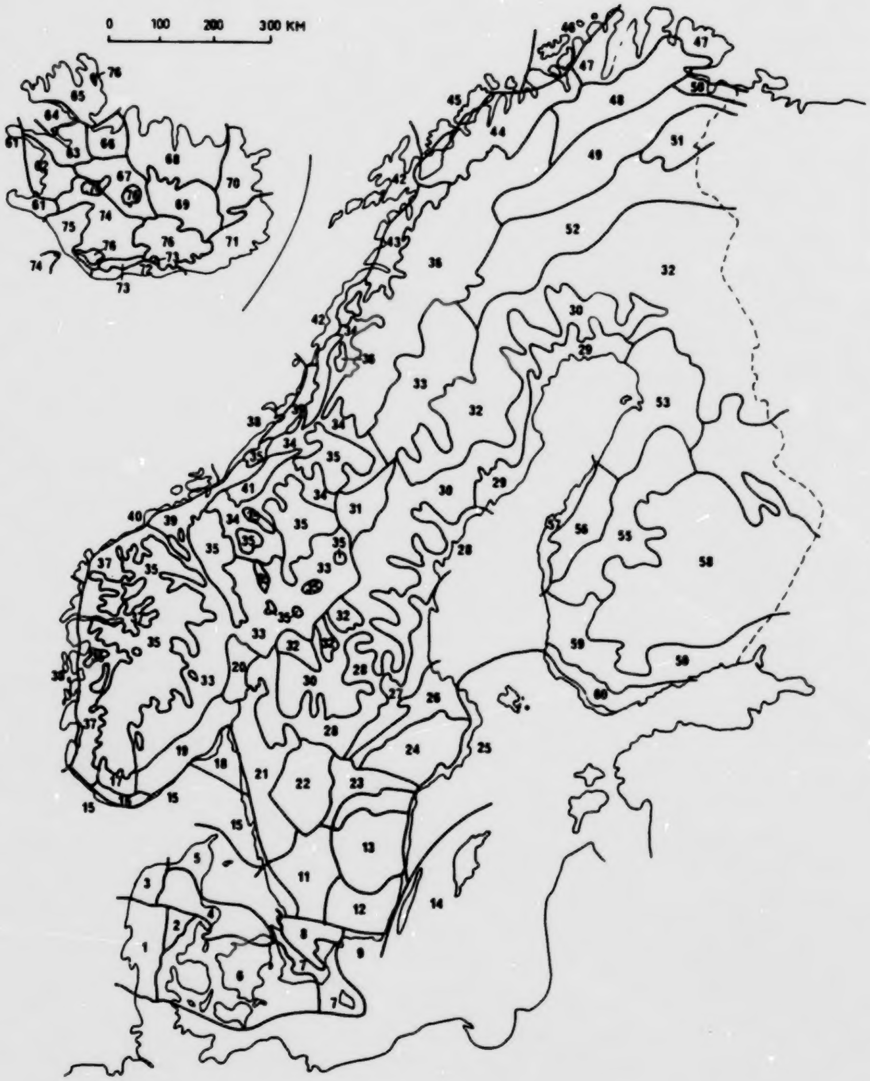


Figure 3 Physical geographical or biogeographical regions of Norden.

- the combination of one component to other components that totally build up the landscape or region.

Land forms, vegetation types and ecosystems indicated by them cannot be regarded as independent variables in the landscape. They can be combined in different ways. A certain combination of vegetation types or ecosystems is experienced in one way if it occurs in the plains and in another way if it occurs on hills or on mountain slopes. The terrain also influences the ecosystems functionally, affecting the intensity of material transport among them. By paying attention to the combination of different landscape components in the planning of land use, conditions are created for a greater variation and a better function in the interaction between different ecosystems in the landscape.

The magnitude of the area that a landscape component or type of nature covers is decisive for its representativity. There are no limit values. However, if a component takes up a large proportion of the landscape's surface it should be regarded as representative. Nevertheless, a component may cover a smaller area but still be regarded as representative. This is the case when a component or type occurs frequently within a landscape but where each occurrence covers a small area. An open landscape may contain many small groups of trees. Another area may contain a dense system of small lakes and mires. In both cases these small areas can completely characterize the landscape and be highly representative of it.

Another situation where a landscape component of a small area may be regarded as representative arises when it comprises a relict from, for example, an earlier culturally-influenced landscape. During an earlier period, the landscape might have been completely open on account of grazing. Pastures and/or heaths then covered more than half the area of the landscape and thus were representative landscape components. Today, perhaps only a few fragments of this open landscape and its ecosystem remain. Instead, the dominating characteristics are fields being covered by bushes and forest plantations. Nevertheless, theoretically the landscape could be re-opened and in the long-run the open ecosystems or nature types that now occur in small areas could appear over larger parts of the landscape.

Vegetation and fauna that correspond to prevailing land and climate conditions, together with different types of mechanical influence (cultural influence), also could be representative. This situation should primarily be historically documented and linked to earlier customs within agriculture and forestry. Nevertheless, it cannot be excluded that new customs may create new representative landscape components in the future.

Within other areas, the mechanical or cultural influence may have been weak or non-existent. The ecosystems and their vegetation types have developed freely into a balance that is similar to that existing in a natural ecosystem (natural vegetation). The "primeval" forest areas belong to this type. If the landscape was allowed to develop independently without human influence this type of ecosystem would cover large areas. Although landscape components of this type are few and on small areas, they must be classified as representative of the landscape where they occur.

Within a landscape certain definite components may occur regularly. Thus, it is the combination that is of decisive importance for the characterization of the landscape. The individual component - terrain configuration, vegetation type, type of nature - will be representative to the extent it is included in a characteristic combination. The interaction between terrain and ecosystem becomes important through the differentiation of ambient factors caused by the land forms.

Structural Evaluation of Nature for Planning - The Rarity Concept

For many years in planning of environment protection the rare and unique in nature has been emphasized as particularly valuable. When evaluating nature from the representativity viewpoint a direct relationship arises between landscape components that are representative and those that are unique.

A representative landscape component often covers a large area or occurs frequently, e.g., it characterizes a landscape. On the other hand, if the landscape component or components occur only within one limited area or geographical region, this component or possibly the whole region will be unique. Examples of regionally extensive and representative types of nature which simultaneously may be regarded as unique are the birch forests on formerly burned land in eastern Finland and the beech forest types in southern Sweden. Areas of the alvar type occur fairly frequently on the islands of Oland and Gotland but are unique in relation to all other regions in the Nordic Countries and also in a wider international perspective.

If the area held by a landscape component decreases there is a greater tendency to regard this as unique even if it might be representative with regard to the natural conditions or to earlier influence of culture. Consequently, the remaining small fragments of, for example, primeval forests or the earlier widespread types of agricultural land and pastures, should be regarded as unique on account of their small areas.

The landscape component can be defined at different levels. If the degree of detail is increased and components at the organism/species level are included, new bases for evaluation may arise. A widespread and extensive type of nature may be unique in that it comprises a particular biotope, species or land form.

The unique may be found in the combination among different components. In the same way as there are representative combinations so there may be unique ones although the components included in the combination may be fairly general and trivial. In this respect, there are often special combinations between natural components that constitute a particular landscape or a particular geographical region. From this viewpoint each region contains a number of both representative and, in relation to other regions, unique characteristics.

Several of the concepts used as criteria for evaluation of the representativity; frequency, area, change and originality, can also be applied when evaluating the rarity concept. An all round evaluation of the natural conditions within an area should, thus, comprise both the representative and the unique properties of the landscape components.

Comment on the Diversity Concept

In addition, use can be made of the diversity criterion. This is frequently used on a higher level than the other criteria when evaluating nature. However, even when diversity is high a combination of landscape elements should be related to the representativity or the rarity concepts. The diversity need not, in fact, be of value and is only given greater importance when it occurs in types of nature that have been documented as being representative and unique.

Model For Processing Information On Nature During Planning

Based on this line of thought, the classification of Nordic landscape components and the subdivision of Norden into physical geographical regions has been structured into a model for processing information on nature during planning (Nordic Council, 1983) (Figure 4). The conditions for a practical use of this model are:

- standardized concepts of landscape components
- inventories of nature and natural areas performed in a standardized manner with the use of standardized concepts
- a subdivision into physical geographical or biographical regions as a frame for the evaluation of structural components
- a network of reference areas representative of the physical geographical regions.

- knowledge of the functions and interactions of components connected to ecosystems for the evaluation of the consequences and possibilities of different forms of land use.

- the establishment of a database which is easy to handle in the planning process. The large amount of information makes it necessary to use computer techniques (Nordic Council 1984d; Osterdal et al., 1977).

Inventories are performed within any planning area using the standardized concepts and methods of the system. The information is stored in the database and thereby ready for comparison with all information collected earlier.

In the analysis, landscape components can be treated singly or grouped, for instance, within ecosystems or concepts of cultural environments, including conflicting land use components. The components are related to the features of the physical geographcial region and/or several reference areas. The reference area ought to have the following characteristics:

- a wide variety of landscape components representative of the physical geographic region in which the area is situated.

- some forms of regulation controlling the conservation and management of their main natural features.

- continuous scientific activities and possibilities to use the nature of the area for education and training.

- documentation of natural features for use as a source of information during planning of the land use within surrounding areas (Figure 5).

Organizing a network of reference areas and an adequate information system for planning has revealed some problems. There are, for example, landscape components of different character. Representative components and many unique ones will be covered by larger "nature type areas" of high diversity. However, some unique features of restricted areas and also landscape components on a detailed level, for example, species of flora and fauna, and local historical structures, cannot be fully embraced within larger areas. Therefore a system of smaller satellite areas, "special areas," in the surroundings of the main reference area is desirable to represent rare landscape components. Concerning components on very detailed level, for example, species of endangered plants and animals, there is a need for information covering the total area of the landscape.

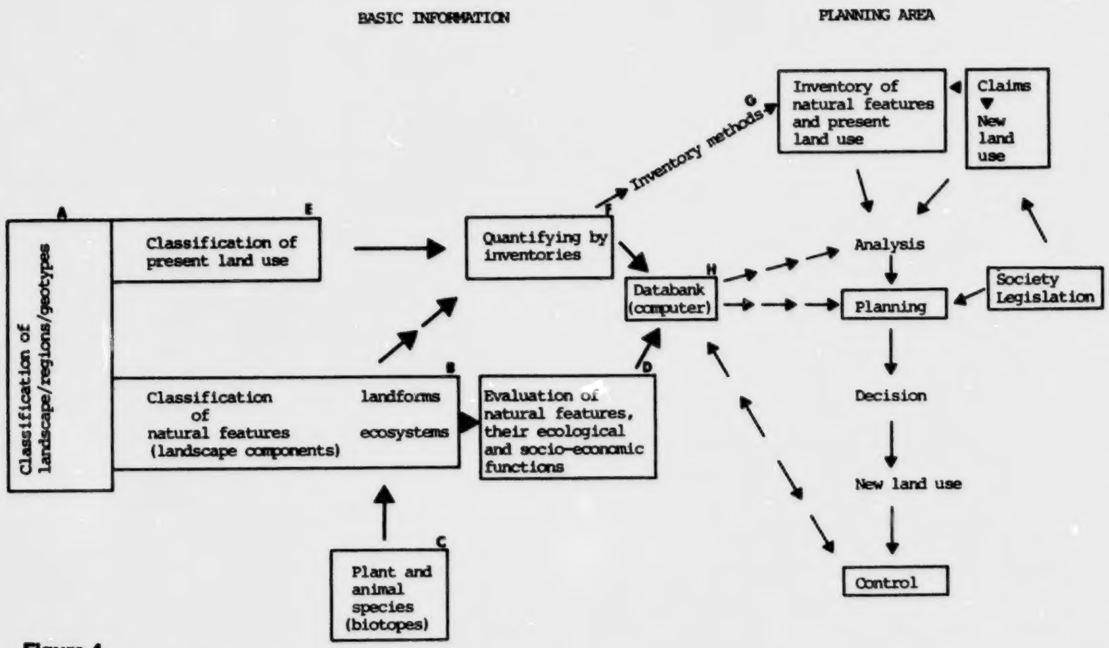
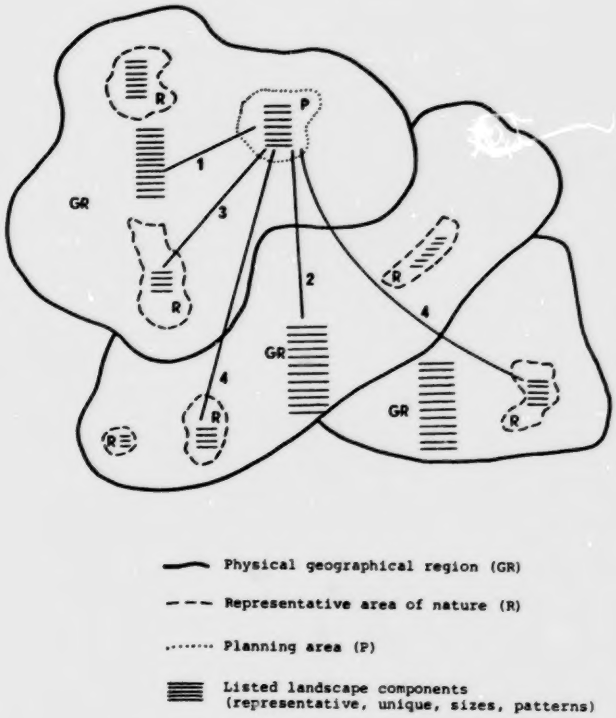

BASIC INFORMATION
PLANNING AREA
A
Classification of landscape/regions/geotypes
E
Classification of present land use
B
Classification of natural features (landscape components)
landforms
ecosystems
C
Plant and animal species (biotopes)
F
Quantifying by inventories
D
Evaluation of natural features, their ecological and socio-economic functions
H
Databank (computer)
Inventory methods
G
Inventory of natural features and present land use
Claims
New land use
Society Legislation
Analysis
Planning
Decision
New land use
Control

Figure 4
Model for processing information on nature during planning


R
P
1
GR
3
R
2
R
4
GR
4
R
GR
R
R
Physical geographical region (GR)
Representative area of nature (R)
Planning area (P)
Listed landscape components (representative, unique, sizes, patterns)

Figures: Examples of different ways to relate the landscape components in the planning area

1) all landscape components (possibly classed as representative or unique) in the physical-geographical region where the planning area is situated
2) all landscape components in other regions (neighbouring or otherwise similar)
3) landscape components occurring in areas which have been selected as particularly typical of the region in which the planning area is situated (representative areas of nature)
4) landscape components occurring within other selected areas (unique, representative for other regions, etc).

Figure 5 Evaluation of the representativity of the landscape components in a planning area.

A database including information on the functions of the landscape components make it possible to analyze the influence of alternative forms of land use on ecosystems and the future consequences. Research is often performed within conservation areas, i.e., the same areas as those chosen as reference areas in a planning network, and in all circumstances with the prerequisite that every scientific investigation on nature and natural functions is connected to the standardized concepts of landscape components. The results can then be used within the model for processing information during planning. Normally the database will be furnished with functional information obtained by compiling facts from scientific papers, reports and the like.

Conclusions

The existence of a network of reference areas based on analyses of representative and unique landscape components of physical geographical regions, combined with a database giving information on natural features and conditions, is a possible instrument in planning for conservation and adequate use of natural resources. Similar ideas have been stressed by different international endeavours during recent years. Systems and networks of reference areas have been proposed as "biosphere reserves" or "representative ecological areas" (Batisse, 1982; Council of Europe 1979; Unesco, 1984). As a principle, such networks can be established on all planning levels–regional, national and international, serving different needs of land use planning.

This approach gives new significance to traditional activities in the conservation and protection of nature. As reference areas the national parks and nature reserves are connected to a planning system as sources of information and knowledge about natural structures and functions. In this sense, conservation can be seen as a basic part of all land use planning and the management of natural resources.

Summary

Land use planning, which in earlier days stressed technical problems of exploitation and economic outcome, must also consider the biological environment. There is a need to use knowledge connected to the biotic and abiotic structures of ecosystems and their functional relationships.

Vegetation types may be used as indicators of ecosystems. A classification of vegetation types occurring in the Nordic Countries has been prepared. The land forms have been described in the same manner. Complementary to these concepts or units of the natural environment, a classification of land use concepts has been devised. The land use concepts are considered as important factors influencing ecosystems and they are also seen as linkages to the management of cultural heritage.

Using the concepts of vegetation, land forms and land use as components constituting more or less homogeneous landscapes, Norden has been subdivided into physical geographical regions. The combination between knowledge of landscape components and their occurrence within regions can be very useful when evaluating natural structures for conservation.

Among different criteria for the evaluation of nature, representativity - as an expression for the landscape's distinctive features - is particularly important. One possible way of assessing the representativity of a landscape component is to use the knowledge of the appearance and occurrence of this component within a region and in areas surrounding it.

Having characterized the representative components of a landscape, it also is possible to define the rare or unique ones based on special criteria. Rare components often can be recognized on smaller areas and in scarce patterns. Sometimes, however, the representative and the rare component overlap. For instance, there are components which are rare regarding the coverage of area but are representative regarding the environmental conditions of the region, for example, fragments of primeval forests. Certain combinations between components have values of their own.

A model for processing information on nature during planning has been constructed based on the following conditions

- standardized concepts of landscape components
- inventories of nature and natural areas
- subdivision into physical geographical regions
- network of reference areas
- knowledge of the functions of ecosystems
- establishment of a database

An information system based on this model will give new significance to traditional activities in the conservation and protection of natural areas. Conservation can be seen as a basic part of all land use planning and the adequate management of natural resources.

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Explanatory Note on Figure 4

The model is based on landscape components that are classified uniformly (b) and related to the landscape (regions) where they are representative (A). Information on individual species of plants and animals can be linked to the landscape components, and particularly the ecosystems (C). This may concern species threatened with extinction but possibly also species of particular economic interest. In addition, information on the functions of landscape components can also be used (D).

In the same way units of present land use is classified and related to the landscapes (regions). Land use also constitutes a mechanical and chemical influence on ecosystems.

The areas and patterns in the different landscape components are documented by means of inventories (F). The planning model assumes that common inventory methods (G) are developed for both basic information and the documentation of individual planning areas.

Computer codes and routines for storage in a database (H) should be available. Programs are designed for direct computer processing of the material against the available information in the basic data system.

Academic Research and Conservation Planning: Experiences from Northern Sweden

G. Hedborg

Norrbotten is the most northern province in Sweden and also the largest, one-quarter of the total area of Sweden. The population is around 260,000. About two-thirds of the province is located north of the Arctic Circle. I live and work in this northern outpost of Sweden. As often when it comes to outposts, the state of knowledge about the province is poor compared to most other parts of the country. This applies especially to knowledge about cultural history and nature. However, there are exceptions. The Saami have been subjected to some research by non-Saami. In the national parks (there are seven in Norrbotten) some work has been done concerning zoological and biological research and also geological and glacial research. If we, for example, look at the field of archaeology, for a long time we assumed that man in prehistoric times never lived in the far north. Today we know that this is totally wrong.

This assumption has led to a situation which is quite interesting. Because the level of knowledge is low, Norrbotten is a place where you can make great, and sensational discoveries. I am saying this just to point out that sometimes lack of knowledge, if it is used in the right way, can be used as a strong argument to attract scientists. Just a few years ago, Norrbotten was considered to be quite uninteresting for archaeologists. Today the province is considered by many to be the most interesting in the country.

In my work I have much worse conditions regarding access to relevant knowledge than my colleagues further south in Sweden. I presume that these circumstances are similar within the whole circumpolar area.

When we work with questions of conservation, the work must have an active character. To achieve success we have to create interest and understanding among politicians, officials and the public. It is of vital importance in my work for me to take an active part in the planning process, both concerning physical and economical planning. To be able to reach this aim, it is of crucial importance to possess and be able to act from sound knowledge. For the conservation of the cultural heritage, the field of knowledge is enormous, from the life environment of the stone age man, from the conditions of the reindeer nomadism, to the history of the architecture of the twentieth century. It is impossible to combine our daily work with research.

That is why I depend to a large extent on close cooperation with the universities. In Norrbotten, we only have a technical university; the nearest university within my field is in Umeå, 125 kilometres away.

What can we do to stimulate research in the north? It is of great importance to have a continuous dialogue with different university institutions. It is important to stimulate and express appreciation.

We must assist in pointing out within what fields research projects are of special importance, in other words, to draw up a regional research program. A research program should, as I see it, in principal be a list of different topics where efforts can be made, both in the form of essays and theses. A regional research program should be flexible and worked out in cooperation with concerned institutions.

The advantages of a regional research program are many. It points out concrete needs and uses of knowledge. Hopefully, it will be easier to get economic assistance for research work which is a part of a regional research program. We have hopes that a research program will inspire more cross-disciplinary work.

We have no regional research program in Norrbotten, but right now we are discussing this question and hopefully we will have one soon.

I have talked about what can be done from the government and user standpoint. I will now suggest briefly what the universities could do. It often strikes me that there is an unnecessary gap between science and conservation. This could be a sign of a lack of communication. With respect to presentations of scientific works, I have some opinions. Too seldom do scientific works reach outside the circles of the academic world. For us who work with questions of conservation it would be very valuable if the scientists themselves more often tried to reach a wider public. Their work could be presented in a more popular version and in a more straightfoward language.

A few years ago, I had a very satisfying experience. A student wrote his thesis about Kiruna, the most northern town in Sweden. The town was founded at the turn of the century when iron ore mining started. The thesis was presented in a very readable way, in uncomplicated language and with rich illustrations. The thesis became very popular and was soon lying on every bedside table in Kiruna. When I started work for a conservation plan in Kiruna the table was already laid. The public and the local politicians were already aware of the cultural historic values of Kiruna. For once I hardly had to argue at all for my cause. It is needless to say that the conservation plan in Kiruna is very ambitious.

The Kiruna thesis is of great value to many people. This was possible just because of the way in which it was written and presented. I am convinced that many more theses could be given a similar presentation. I am also convinced that if this was the case, the public support for research work would be better: I believe that it is easier to receive financial support for projects that many people support.

I often look upon myself as being in an intermediate position between the academic world and the public and politicians. As a daily task, my colleagues and I have to try to make politicians understand conservation values. We often use and are dependent on knowledge that comes from work done by universities. Working in an outpost, where the need for new knowledge is specially great, I have had many thoughts about questions of cooperation. My hope and my ambition is that the special situation of Norrbotten as an outpost will create conditions for and lead to cooperation which could be a model for other parts of my country. In some areas we have already reached this point. I am convinced that this would be to the benefit of all, including the public of Norrbotten.

I believe the most important step to be taken in my area of northern Sweden is to develop a strategy for the gathering of knowledge. I believe, after having visited colleagues in northern Canada, that this is true for northern North America as well. There is and will always be, a limited amount of money available for research in the north. In order to increase the resources and to get as much as possible out of the money that is available for research, my belief is that it is of crucial importance to work out a strategy and a research plan.

Finally let me say a few short words about indigenous people based upon experiences with Saami. There is a somewhat tense situation between the Saami and the Swedish society. The Saami have been subjected to quite a bit of research by non-Saami. They have been put under the magnifying glass. I think it is important to encourage all Saami who have an interest in their own heritage, to educate themselves. The schools, the universities, people like me and others must assist them to train and educate themselves and to become the researchers in their own land. Currently, we are taking a big step forward in my province in this regard. In Jokkmok, there is an eco-museum under construction. In the museum, there will be an independent Saami department, with Saami scholars on the staff and with a board only of Saami. For the first time in my country, the Saami will get the opportunity to work with their own heritage in a professional way. This is one of the most important steps that has ever been taken concerning the heritage of the Saami people in Sweden.

Critique of Land Use and Conservation in the Arctic: Session II

Walter Gryba

In this critique comments are first made about the session papers individually and then a summary is offered at the end.

A Northern Conservation Strategy by Rodger Schwass, John Naysmith and Julian Inglis

The themes presented by Schwass, Naysmith and Inglis are a good encapsulaton of the history, conclusions and implications of the report of the Task Force on Northern Conservation. The policy framework suggested by the Task Force, the strategy and ongoing mechanisms for implementing policy and the specific set of actions over the next two years reflect thoughtful and well ordered thinking and very good handling of difficult conceptual problems. These include: definition of principles and goals for a comprehensive strategy; establishment of institutional arrangements and structures for implementing the strategy; and the delineation of areas and regions of environmental significance.

In reading and re-reading the papers and the Task Force report itself, a few issues/questions recur. The first is the hope expressed at the very end of the Memorandum to Ministers which accompanied the report that ".....it is our hope that this report, which takes a pragmatic approach, will provide an impetus for governments to adopt a northern conservation ethic and implement an effective strategy." This hope is central to the issue of whether or not there is the will to *do something* with the recommendations of the report. In writing this critique, that question above all others comes to mind at every turn.

A second issue related to the first is that of institutional arrangements. When one thinks of such events as proposed division of the Northwest Territories, devolution of powers to native organizations under land claim agreements and the like, a note of pessimism tends to creep into the picture. Achievement of the laudable objectives which support making these changes may be a depressingly difficult task if the will to achieve it falters or is lacking.

A third concern or issue is the formation of a "Conservation Advisory Board." The idea is a good one: but in the light of the wide array of boards, councils and similar bodies related to the north which already exist, the establishment of the Board will need special handling if it is to succeed.

The suggested "short-term" role of the Advisory Board is sound if the Board is indeed established; and there is no quarrel with the long term role.

A potential obstacle to forming the Board is the restraint policy of the Government on the grounds that some backup resources, e.g. a secretariat may be needed, but funds are not available. In the reviewer's opinion this weak (but probably popular) argument should not be acceptable, for the cost of *not* providing such resources would be far more inhibiting.

Finally, and related to the question of the "will" to do something, it is this reviewer's opinion that the recommendations of the Task Force are as clear and logical as one could hope for: but the challenges of doing something can begin to be met by all departments and agencies if they respond now, and clearly, with their views on how they might implement them. Alas, to date, such responses are not in evidence.

The Role, Identification, Designation and Implementation of Environmentally significant Areas in the Northwest Territories by Paul G.R. Smith, J. Gordon Nelson and John B. Theberge

This paper hits hard at the lack of action in designating areas of environmental significance and taking steps to ensure that their special features are managed in a coordinated and rational manner. Quite rightly, the paper states that before a comprehensive land use planning effort is mounted in the NWT, these Environmentally Sensitive Areas (ESAs) should be identified and delineated; and then takes the positive approach and recommends a process for doing so.

The reviewer choses not to address, point by point, the contents of the paper for the simple reason that he fully agrees with it and can only urge that it be adopted. The concern that there is no coordinating ESA body to make the ESA system work is shared; but as this reviewer has stated in relation to other papers presented during the symposium, lack of 'will' to do something is the key blockage to its implementation.

Land Use Planning for Conservation by Lars Pahlsson

This paper presents a model for evaluating the natural environment in the conservation land use planning context. Biogeographical regions, with land forms and vegetation types as ecosystem indicators are classified in a standardized manner as a base for use by planners.

For the system to work, large amounts of data and information must be handled, and the use of computers becomes an imperative. The examples cited (LINA) and (LINREG) where this approach was used in Sweden appear to prove the worth of the approach.

Based on the LINA and LINREG results it is suggested that new significance can be placed on conservation as a basic part of land use planning and management of natural resources.

The proposition makes sense in that there is now sufficient state of the art technology to handle vast amounts of information. The challenge is to "translate" the information into appropriate formats to take advantage of this technology. In the reviewer's opinion Pahlsson's idea merits further development.

Academic Research and Conservation Planning Experiences from Northern Sweden by G. Hedborg

Hedborg presents in concise terms the role of academic institutions in the conservation process. His perspective is one that can readily be shared by most people who are involved in work in the remote areas of the world. He makes the important point that the interest of politicians, the public generally and bureaucracies has to be sparked, and "sold" so that there are "champions" for the cause. Without "champions" with the will to facilitate and encourage research as differentiated from day to day operational management, those working in the north cannot fulfill their mandate.

Open dialogue, good communications, a systematic and coordinated approach and practical goals and targets are key to effective research which produces practical results. In northern regions this is essential. There is no need for a gap to exist between university research and field research. From a northern perspective based on practical experience, Hedborg delivers a worthwhile message.

Summary

The opportunity of participating in the Symposium in a direct way is much appreciated; and especially so because as a general management person, it is a rare opportunity to participate and become involved with the academic/scientific conservation community on a direct basis. To hear and discuss their views of conservation issues adds much to one's appreciation of the scope (and the difficulty) of being a conservationist in a competitively exploitive world.

The authors of the papers I had an opportunity to review, and indeed all contributors gave a fine display of thoughtful and diligent pursuit of the many issues involved and they deserve full marks.

One recurrent question emerges: How much effect will the scholarly research and study reflected in the papers of this symposium and the conclusions and recommendations have on the national and world scales? How much advancement of the conservation and preservation ethics will be made?

Reluctantly, one is drawn to the conclusion that while symposia such as this will undoubtedly lead to some progress, they are unlikely to have a major impact unless the "WILL" to do more about conservation and preservation is there at the general public, political and senior management levels of society. That leads to the next question: "WHY?"

With utmost respect and recognition of the credentials of the academic/scientific community, it is my conclusion that because of the lure of introspection, of professionalism along narrow corridors of research and teaching, and the all-too-human tendency towards focussing on the detail and intricacy of our biosphere, the academic/scientific community is forgetting that their major audience is not scientific, academic or particularly interested in such matters unless, some event (oil spill, forest fire, PCB spill) occurs which threatens them or their immediate surroundings. What is also forgotten all too often is that the major audience does not understand the "lingo" of science and academics. The wider audience understands the word "wind" - that's what makes the sea choppy, roof shingles fly and telephone lines fall. Not many understand that a "high velocity cyclonic disturbance aggravated by an increasing lapse-rate" does the same damage! Nor is that audience much inspired to put dollars and political clout behind "cyclonic disturbance mitigation", but they are willing to pay plenty and pass legislation for breakwaters, underground telephone cables and ceramic tiled roofing on their buildings to beat the effects of "wind damage!"

The message, therefore, is that the "will" to support ventures and works and recommendations such as discussed at this symposium can not be found unless there is a strong determined effort to reach the major audience with words and media that they can readily recognize and relate to their own social, economic and political needs, wants and aspirations. I submit that conservation can gain support, and indeed generate "product champions" from the wider audience if it is presented in a simplified, crisp and appealing manner. And that is the challenge I put to the participants in our academic and scientific community. If that community can achieve what is essentially a successful promotional and marketing-oriented approach to selling their "product" the customers will buy the product and want more of it.

Land Use and Conservation in the Arctic: Session III

John U. Bayly

In our dealings with one another as human beings, we set ourselves the highest standards. In my own field of law, we believe it is better that a thousand guilty men are set free than a single innocent man be sentenced to the gallows. To avoid unjust convictions, we require that the state prove the guilt of a man beyond a reasonable doubt before the weight of the law is brought to bear against him.

It seems that similarly high standards and difficult tests are set to be met and performed before lands can be set aside for conservation purposes or before man's activities will be restricted in order to protect the physical features, the flora and fauna or the carrying capacity of the land.

The Task force on Northern Conservation has recently recommended the adoption of the World Conservation Strategy's definition of "conservation".

> Conservation is the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations; it emphasizes the maintenance of cultural resources and representative or unique ecosystems, their ecological processes and genetic diversity.

Such noble goals, and how beautifully they are expressed! One would think that if this conservation standard guided and governed our activities, men would have to prove beyond a reasonable doubt that their proposed activities not only put the land to its best use but that the use would not affect the land's ability to provide benefits for future generations.

In fact, we plan, plead for and carry out our uses of the land with quite different goals in mind. We are subjected to far less rigorous standards that the World Conservation Strategy's definition would impose on us.

Writing fifty years before his ideas became fashionable in America and a century too late to reverse the effects of man's abuse of the New World, Aldo Leopold describes man's unconsciousness of the need for conservation even in his own interest:

> I am sitting in a 60 mile-an-hour bus, sailing over a highway, originally laid out for horse and buggy. The ribbon of concrete has been widened and widened until the field fences threaten to topple into the road cuts. In the narrow thread of soil between the shaved banks and the toppling fences grown relics of what once was Illinois, the prairie.
>
> No one in the bus sees these relics. A worried farmer, his fertilizer bill projecting from his shirt pocket, looks blankly at the lupines, lespedezas or Baptistas that originally pumped nitrogen out of the prairie air and into his black loamy acres. He does not distinguish them from the parvenu quackgrass in which they grow. Were I to ask him why his corn makes a hundred bushels, while that of non-prairie states does well to make thirty, he would probably answer that Illinois soil is better. Were I to ask him the name of that white spike of pea-like flowers hugging the fence, he would shake his head. A weed, likely. (Leopold,1966)

In Canada we are witnessing for the second time this century the blowing away of prairie soils which were once preserved through lengthy drought by thick prairie sod and replenished by plants few of us have ever seen. We must acknowledge that the World Conservation Strategy's definition is a goal well over our North American horizon. Our 1980s practical standard is "How can we do what we want to do to maximize our economic returns from the land and at the same time minimize or contain the damage and degradation to the environment?"

Meeting the needs of future generations is something we do not readily accept as our individual land use responsibility. On privately held lands, or lands claimed or leased for commercial purposes, we decline to meet the standards the World Conservation Strategy definition would impose. The legal standards protect us in our reluctance and encourage us to maximize short term productivity.

At the same time, we expect that before land can be put beyond our use for economic gain or its commercial uses restricted, it must be proven to the highest standards that cultural resources are worthy, areas to be set aside truly representative or unique, and ecological processes and genetic diversity of sufficient public interest that lands can be sacrificed and left out of production in the name of conservation. This is the burden of proof which must be overcome before we will permit lands to be preserved for future generations.

This is not a situation unique to North America. Hedborg recognizes that, in Northern Sweden, scientists must do planned coordinated research and they must publish that research in popular form to elevate public consciousness about land and the need to conserve it. Only then will there be enough interest to set areas aside and restrict man's uses of them. He recognizes in his own country how much work needs to be done to provide the basis of knowledge necessary to make wise conservation decisions. In his country the indigenous Saami have begun to contribute to the knowledge base with their own scholarship. We can only hope to see similar scholarship by Inuit, Dene and Metis of northern Canada enriching our knowledge of the country and its people.

Pahlsson acknowledges that conservation of land, except for human recreation, was not a factor to be considered in land use planning in Nordic countries until very recently. He recommends having the most exhaustive and up to date inventories and analyses of land characteristics as evidence that lands are worthy to be set aside or land uses restricted in the interests of conservation. Computer techniques have been devised and can be employed to handle volumes of evidence and the environmental detective work necessary to choose just the right sites and presumably to avoid "over-representation" of certain types of land. How effective his approach can be in northern areas where there is a paucity of knowledge remains an open question.

Smith, Nelson and Theberge have recognized this burden of proof in northern Canada and, although their approach to environmentally sensitive areas may not yet be computerized,* it is similar to that described by Pahlsson. While they have not addressed the adequacy of the knowledge base or ways to acquire necessary knowledge to make their approach most effective, they do recognize the difficulties in satisfying a public with diversified and often competing land-use goals. They seek ways to break the stalemate which has prevented the setting aside of environmentally sensitive areas for protection even where such areas have already been identified. They point out that 122 sites have been identified but remain formally unprotected.

Smith, Nelson and Theberge say that "the proper identification, delimination and management of environmentally sensitive areas should be a first step in any comprehensive land use planning program in the NWT". It should be too, but I doubt that it will. Valuable resources such as oil and gas and minerals are found in environmentally sensitive areas with discouraging regularity. The most economical transportation routes to market often parallel those used by migrating animals and birds, and transect rivers and streams frequented by fish. The danger is not only that the organized extraction of resources and their economical transportation will continue to be the primary considerations of land use planning, but also

* Editor's Note: The system is partially computerized for the eastern Beaufort Sea area and could be completely so, given resources and further effort.

that the burden of proving environmental acceptability will continue to be made less onerous in order to stimulate economic activity on the frontier. At the same time, areas to be set aside and conserved for future generations will continue to be tried and judged by a jury composed of all those with competing land interests and a variety of conservation ethics.

If only land use planning and environmental assessment reviews were conducted like the search conferences Schwass describes as the first step in the work of the Task Force on Northern Conservation. There, key representatives of the major parties with interests in land were asked:

1. to explore the future situation to the end of the century if nothing is done to reverse future trends;
2. to try to agree on a desirable future;
3. to discuss in detail the obstacles which obstruct the way to the future; and
4. to identify opportunities to overcome or get round the obstacles to reach that future.

I would like to see the method tested in the environmental assessment of an industrial project. Would the proponents' goals, the national interest, however defined, and local priorities intersect to form a single desirable future? I remain skeptical.

It its quest for a desirable future, the Task Force on Northern Conservation recognized the competing views of land and resources in Canada's Yukon and Northwest Territories. Two salient facts of life are considered: "the major economic and employment generating role of the non-renewable resource sector; and the critical long term economic, social and cultural importance of the land, water and renewable resources". These two are not described as irreconcilable. Instead, it is proposed that we adopt the World Conservation Strategy definition of conservation as a land management objective and as an added measure that a network of specially deserving protected areas be set aside in perpetuity.

As the primary tool for shaping the desirable future, the Task Force proposes the integration of resource management or the "one-window" approach to project assessment and licencing. This is not a radically new idea but the Task Force believes it will work in the Territories, particularly when the infant land use planning system reaches maturity and when the aboriginal land claims are settled. Presumably the Task Force believes those two happenings will re-establish a power balance between the two major facts of life, land as commodity and land as intrinsically valuable.

Here, the Task Force is preaching to the converted. It does not help us to deal with the problem that few accept the World Conservation Strategy as their credo in land use planning. Among those who do are the aboriginal peoples of Canada's north. In spite of the temptations of land and resource exploitation, the Dene, Metis, Inuit and Inuvialiuit of Canada's North pursue, through their aboriginal land claims, conservation principles and the setting aside of lands for protection. They do not trust governments to make wise conservation decisions in their long term interests. They are insisting that they be part of the decision making process.

But even the aboriginal peoples, whose ethic is similar to that proposed by the World Conservation Strategy, are divided. Like Eve in the Garden of Eden, they have tasted the forbidden fruit of the "now" and "me" generation. Some will welcome the economic exploitation of northern lands and the resultant employment and economic opportunities.

If we accept the World Conservation Strategy definition we must recognize, as the Task Force did, that the definition tries to stand between two views – that lands and resources primarily are for man's use, now or later, and that land and resources are valuable for themselves.

As Leopold wrote in the introduction to his *Sand County Almanac* in 1948

> Conservation is getting nowhere because it is incompatible with our Abrahamic concept of land. We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect. There is no other way for land to survive the impact of mechanized man, nor for us to reap from it the esthetic harvest it is capable, under science, if contributing to culture
>
> That land is a community, is a basic concept of ecology, but that land is to be loved and respected is an extension of ethics. That land yields a cultural harvest is a fact long known, but latterly often forgotten. (Leopold,1966)

Perhaps love and respect for land lie behind the World Conservation Strategy definition of conservation. If so, these qualities do not shine through. Perhaps the definition is what it appears to be–a compromise between those who see land as a commodity and those who see land as a community to which we belong.

What is not stated but is an underlying assumption in all the papers presented in this part of the conference is that those who see land as a commodity are in ascendancy. Those who see land as a community must try to convert the others before it is too late. At the same time, like those trying to salvage heirlooms and valuables from a house fire, we must rescue what we can and set it to one side as far from the flames as possible.

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Summary of Discussion on Land Use and Conservation in the Arctic: Session II

Editors

Discussion following the morning session was divided into two distinct components. The first component was a varied question and answer series related to specific methodological aspects of the Canadian land use planning and analysis approaches and the Northwest Territories conservation task force report. The second component was a more detailed consideration of two broad themes–the uncoordinated nature of research in the Canadian North and the complex task of improving information dissemination and southern Canadian knowledge of northern environmental issues.

In the context of the second component, much concern was expressed about lack of both *a continuous northern research audit* and a national *northern research policy*. A research centre or clearinghouse was proposed and the question of Association of Canadian Universities for Northern Studies (ACUNS) involvement in such an endeavor was raised. The present void was described by several symposium participants as contributing to (i) *research ineffectiveness*, i.e. in too few of the right issues or problems being addressed; (ii) *research isolation*, which results in too little information reaching scientists and other interested parties; and (iii) *research redundancy*, which results in scarce financial and other resources being allocated to studies of similar type.

The opinion was expressed that these concerns are not endemic to Canada and that they are indeed shared by all circumpolar nations. In addition, authors were reminded of their moral responsibility to present research findings in public fora and not just to professional offices.

LAND USE AND CONSERVATION IN THE ARCTIC: SESSION III

Ice off Cape Graham Moore, Bylot Island
Courtesy: Murray McComb

Shipping and Marine Environmental Protection in the Arctic: Present Approaches and Future Options

D. VanderZwaag
C. Lamson

Introduction

The topic "Shipping and the Arctic Marine Environment" may seem untimely to some persons, for the transport of cargoes through arctic waters does not seem to be a pressing issue. The Arctic Pilot Project, a proposal to ship liquefied natural gas (LNG) from Melville Island in the Canadian Arctic through the Northwest Passage to European or southern markets is on indefinite and perhaps permanent hold. The proposal by Beaufort Sea operators to ship oil in ice-breaking tankers through the Northwest Passage or around western Alaska is cloaked in uncertainty since an Environmental Assessment Review Panel, in July 1984, issued a report favouring a small-diameter, overland pipeline and recommending a cautious two-stage research approach to marine shipping. A research and preparation stage would study such questions as the effect of tanker traffic on marine mammals and the need for increased government support systems such as hydrographic charting and ice-detection systems. A two tanker stage would involve actual field trials and performance studies with two Arctic Class 10 ice-breaking tankers.

However, the topic "Arctic Shipping" is relevant to the theme Arctic Heritage, because arctic marine transportation is a high-risk activity and, as traffic levels are likely to increase within the next decade, the likelihood of a major pollution incident or accident also increases. The Northwest Passage offers an attractive short-cut for international shipping. For example, the open sea distance between Yokohama and London could be reduced from approximately 14,650 nautical miles to less than 8,000 nautical miles. A North Pole Passage would trim a voyage from Yokohama to Rotterdam from approximately 15,640 nautical miles to about 6,610 nautical miles. Shipment of oil from the Canadian Beaufort Sea to Japan is a future possibility, since Japanese companies have invested $400 million in Beaufort oil exploration and the Beaufort Sea is only 3600 nautical miles from Yokohama, approximately half the distance from Yokohama to the Persian Gulf (Pullen,1984). Panarctic Oils Ltd. has discovered major hydrocarbon deposits in the High Arctic Islands and plans to ship 100,000 barrels of oil from Cameron Island through the Northwest Passage in the summer of 1985. If successful, Panarctic might eventually develop further oilfields, such as Cisco off the coast of Lougheed Island estimated to contain 300 million barrels of oil, and could open the Passage to year-round transits by ice-breaking tankers.

This paper briefly examines the relationship between arctic shipping and the marine environment through a five part analysis: 1) present and projected shipping in Canadian arctic waters 2) environmental risks of arctic shipping 3) Canadian legislation and administration for control of vessel transits 4)the international legal regime for managing shipping in northern waters and 5) options for strengthening national and international approaches to better assure safe and efficient arctic shipping.

Present and Projected Levels of Shipping Activity

Ships are the lifelines of the southern industrialized world into the Arctic. They perform essential services including community resupply, facilitate scientific research, and support northern industrial and military activities. Until the voyage of the *Manhattan* in 1969–the era of the West Greenland whale fishery (eighteenth and nineteenth centuries) and the period of Distant Early Warning (DEW) line construction (1950s) excepted–arctic surface vessel traffic was sporadic, seasonal and largely task-specific. However, in the last decade, the discovery and development of offshore hydrocarbons and land-based mineral deposits has abruptly and unalterably changed the level and scale of arctic marine transportation activity.

Responsibility for coordinating "the assembly, transportation and delivery of all supplies for government departments to the Eastern and Western Arctic" was delegated to the (then) Department of Transport in 1959, by Order-in-Council P.C. 1959-38/304. Since then, responsibility for Western Arctic resupply has been transferred to Northern Transportation Company Ltd. (NTCL). Government operations, including federal and territorial government agency activities, accounted for the largest proportion of northbound cargo (dry bulk and fuel oil cargo) until 1971, when, for the first time, the requirements of commercial operations (principally oil and mineral exploration activity), surpassed government shipments of cargo. Forty-four eastern arctic sites were being serviced by ten bulk cargo vessels and five bulk fuel oil ships in 1981 (Giuliana,1983). Preliminary Transport Canada statistics for the 1984 shipping season indicate that sixty-five cargo-carrying and escort vessels were granted authorization to enter arctic zones, and the majority of vessels made multiple or lateral port calls. Approximately 20 ships made two or more trips between southern or European and arctic ports. Of the estimated 85 ship trips in total, 14 involved tankers, 29 were bulk carrier vessels, and 23 were general cargo vessels. Coast Guard vessels, research ships, and tugs accounted for the remainder of eastern and central arctic shipping activity.

In the Western Arctic, communities in the Mackenzie River Basin and along the arctic coast are served primarily by a tug-barge system. Vessel traffic and movement of cargo fluctuates in response to overall regional economic activity, as indicated by annual statistics which show a dramatic increase between 1968 and 1972 (from 107,772 tons to 434,856 tons), declines to 1977, and another upward trend in recent years (to an average of 350,000 tons). In 1984, the Water Transport Committee of Transport Canada issued operators' permits to ten licensees with a combined total of 339 ships. NTCL is the major carrier with a fleet of 247 ocean-going ships, tugboats and barges (Canadian Transport Commission 1978;1984).

Industrial vessel traffic is tied directly to levels of northern resource development activity. Canarctic Shipping Co. Ltd. operates the *M.V. Arctic*, an Arctic Class 2, oil-bulk ore carrier, which makes five to six trips annually from mining sites on Little Cornwallis Island and Nanisivik, N.W.T. to European markets. Two other shipping companies, Brostrom and Federal Commerce and Navigation also transport ore concentrates from the Polaris and Nanisivik mines in three bulk cargo ships, *Columbialand*, *Federal Elbe* and *Federal Huron*. In 1985, the *M.V. Arctic* is scheduled to transport the first shipment of crude oil produced from Panarctic Oils' Bent Horn field on Cameron Island. Offshore hydrocarbon exploration activity in the Beaufort Sea is responsible for the highest levels of arctic industrial traffic. Gulf Canada Resources Inc. operates a fleet of five vessels - *Gulf Beaufort* (oil tanker), *Terry Fox* and *Kalvik* (Class 4 ice-breakers), and the *Miscaroo* and *Ikaluk* (Class 4 supply vessels). Canmar Marine Drilling Ltd. (Canmar), a wholly-owned subsidiary of Dome Petroleum Ltd., operates 19 vessels in the Beaufort Sea, including the *Kigoriak* and *Robert LeMeur* (both Class 3 ice-breaking/anchor handling supply vessels). The Canarctic, Gulf and Canmar vessels are state-of-the-art ice-breaking vessels, designed specifically for arctic operations in Canadian waters. In addition to task-specific activity these vessels have also served as research platforms for design and performance testing for the next generation of arctic ships.

The current Canadian Coast Guard fleet consists of eight heavy ice-breakers, seven medium ice-breakers/navaids tenders and seven light ice-breakers/navaids tenders. However, the fleet is aging rapidly and even the most powerful ship, the *Louis S. St. Laurent* (17,896 kw), is restricted to seasonal operations due to its Arctic Class 3 rating. The Coast Guard has let tenders for the design of Polar Class 8 vessel, but no firm decision has been taken on construction start-up. Given the petroleum industry's vision to operate Arctic Class 10 tankers from arctic production sites, the Canadian government will not be capable of supporting or monitoring industrial activities without equivalent vessel capacity, or implementation of technologically-sophisticated and expensive satellite monitoring systems.

Four other arctic sea vessel groups–scientific research, fishing, military, and tourist–complete the inventory of arctic vessel traffic in Canadian waters. The Bedford Institute of Oceanography regularly sends the CSS *Baffin* and CSS *Hudson* into the Arctic on research cruises. Fishing activity is limited to experimental fisheries development efforts, and Canadian military efforts are restricted by the lack of ice-capable vessels. There is, however, a public list of submarine transits of the Northwest Passage by US and Soviet vessels, indicating that sub-surface activities may not be uncommon (Pharand,1984). In 1984, the first tour ship, the *Lindbland Explorer*, made a successful east-west crossing of the Canadian arctic with support by the CCGS *Camsell*. Other arctic tours are being planned, including a 1985 trip by the *World Discoverer*.

Demand projections through 1995 indicate that the number of one-way ship transits across the Canadian Arctic could increase as much as sevenfold from 1980 levels of traffic (30 to 220 vessels), although these forecasts were predicated on the start-up of commercial production of Arctic Islands; gas by 1986 and Beaufort oil by 1987 (Transport Canada,1982). Even if initial traffic projections are overstated, the Canadian government is faced with a number of major arctic service policy questions which require decisions based on long-term planning, as opposed to short-term economic or political considerations. For example, existing port and harbour facilities are inadequate to serve present needs. In addition, search and rescue services, navigation and communication systems, hydrographic charting, ice and weather forecasting, pollution control, oil spill clean-up technologies, vessel routeing and traffic management systems are at various stages of design, testing and implementation. Serious questions about the extent of government responsibility for providing equivalent levels of service to all users have not been resolved, although implementation of some form of user-pay system is not unforeseeable (Transport Canada, "Arctic Services Policy," 1982).

Environmental Risks

There are two categories of environmental risks associated with arctic marine transportation. The first category involves ship-environmental interactions. Transport Canada's annual summary of marine casualties reported some 31 incidents in northern waters during 1983. In 1982, only 14 incidents were reported, suggesting that expansion in overall traffic density also increases the chances of casualty occurrence. The majority of 1983 incidents (17) occurred as a consequence of ice damage although other causes, including heavy weather, vessel handling and manouvering, and equipment failure, accounted for the other incidents. Four tankers, *Eastern Shell*, *Le Saule No. 1*, *Gulf Mackenzie* and *Gulf Beaufort*, sustained ice damage although no pollution reports were filed. The *Arctic Ublureak*, a Beaufort survey vessel, sank after collision with an offshore drilling caisson on August 31,1983 (Transport Canada,1983). Improving ice capability and construction standards, however, will not be a sufficient response for enhancing arctic marine safety. A spokesman for the Norwegian classification society, Det Norske Veritas, has stated that, "it looks like high ice strengthening has provoked damage, because ice has willfully been confronted that otherwise would have been avoided" (Arctic News Record,1984). This assessment was reiterated by the Coast Guard's marine casualty investigating report of a 1978 incident involving the *M.V. Arctic*: "...the ice damage was caused by attempting to use the vessel as an 'ice-breaker' rather than an 'ice-strengthened' cargo vessel." The report also cited lack of arctic ice navigation experience by the vessel's deck officers as a contributing factor to the accident (Canadian Coast Guard,1978).

The second category of arctic environmental risk concerns the potential of vessel traffic to adversely affect marine biological populations and species' habitats. Marine mammals may be physically at risk to vessel traffic, operating in open water or in ice, from direct collisions or through impairment to sound production and hearing. Other concerns are that marine species may modify their behaviour in response to vessel traffic to avoid confrontation or contact. The immediate and long-term effects of oil pollution in polar regions are also highly speculative. Despite major environmental research programs, the arctic data base is still far from being adequate. Many risk assessments are based on information extrapolated from events occurring in more temperate regions, or from data derived from a limited number of experimental research projects such as the Baffin Island Oil Spill (BIOS) study, or the cooperative US-Canadian-Danish/Greenlandic investigation of the noise effects of ice-breaking ships in the Baffin Bay/North West Passage in 1983. A 1983 report commissioned by the Department of Fisheries and Oceans' Arctic Research Directors Committee concluded that, based on available scientific information, slower moving baleen whales would be at risk from collisions, although mortality rates could not be predicted (Mansfield,1983). Ringed seals inhabiting pack or fast ice in Parry Channel would be at higher risk than seals in the eastern arctic if traffic avoided inshore bays and inter-island channels. The potential impacts of vessel noise on arctic mammal populations is thought to be a function of power output rather than operational environment. For example, ice-breaking-generated noise levels were found to be comparable to recorded levels of noise associated with natural ice ridging. Since noise levels are dependent on propeller blade size and speed, conventional vessels may generate higher levels of noise than their more modern, technologically-sophisticated and larger sisterships. An estimated comparison of source levels from the CCGS *Louis S. St. Laurent* and a Class 10 LNG tanker operating at similar speeds indicated that the Coast Guard vessel would generate higher levels of underwater noise. Since both speed and power output (through vessel design and construction details) are subject to human control, these factors might be incorporated into future vessel traffic regulations. Bowhead whales, ringed seals and beluga whales are thought to be the most likely species affected by ice-breaking ships. Communications and behaviour may be interrupted or altered for distances from a ship ranging from 300 kilometres for bowheads, to 5 kilometres for belugas and 40 kilometres for ringed seals. Again, traffic density and frequency are key factors influencing the sound environment, but a threshold figure of 11 tankers, operating regularly and evenly spaced, has been forecast to ensonify continuously the bowhead's pack ice environment.

The potential effects of oil pollution on arctic marine biota are not completely understood. Arctic species are not innately more sensitive than species in more temperate zones to oil pollution, however, special conditions of the arctic environment may prolong the toxicity exposure period. Furthermore, recovery may take more time, given the relatively slow rates of weathering and biodegradation, and characteristically lower fecundity, growth and dispersal rates in the Arctic (Percy and Wells,1984). Timing and location appear to be the key variables in assessing potential environmental damage from a pollution incident. Pack ice is used by ringed seals during pupping. Ice edges, polynyas and leads serve as important feeding, reproduction, migration and overwintering sites for many arctic bird and mammal populations. However, these same areas will be jeopardized by increased vessel traffic because ships navigating in ice will most probably seek out the lead systems as preferred routes (Dey,1981).

As arctic shipping technology advances and offshore interests pressure for accelerated development with extended navigation seasons, the need to provide a framework for adequate environmental protection is urgent. Industry, with substantial funding from the Canadian government, is pursuing research and testing of risk avoidance technologies that ultimately may serve conservation and protection interests as well as industry interests. For example, Arctic Canada Ltd., is designing an "Arctic Shipping Probability Evaluation Network" (ASPEN) model to help forecast the occurrence of ship/ice collisions and to assess the costs of ice-inflicted damage. While this model is currently limited to vessel-related damage it may be possible to add other dimensions such as potential risks to marine species and habitats given specific locations and time periods. A second approach is known as REMSCAN–a combined remote sensing, navigation and communication system. REMSCAN is designed to facilitate three levels of navigational support: long-range strategic route selection (providing comprehensive coverage of ice conditions over several days), close-tactical, and tactical remote sensing. Close tactical sensing would assist immediate operations by detecting objects within a 6 kilometres range, while tactical sensing would help the navigator anticipate conditions ahead (up to 800 kilometres) and along a 30 to 200 kilometres corridor. Satellite and radar technologies will be utilized to transmit accurate and real-time information between a shore-based communications headquarters and vessels in the arctic (Dome Petroleum,1982).

Canadian Legislation and Administration

Canadian law and administration for managing arctic shipping consist of two major types of controls--project assessment and approval, and shipping management.

Project Assessment and Approval:

For deciding whether industrial development proposals with a shipping component (for example, offshore hydrocarbon exploration or coastal mining) should be allowed to proceed, Canada has a fragmented and rather *ad hoc* decision-making system. At least six federal departments or agencies hold major decision-making strings over northern project proposals, and the public is guaranteed only minimal legal rights to participate in the decision-making process.

The Department of Indian Affairs and Northern Development (DIAND), pursuant to the Arctic Waters Pollution Prevention Act (section 10), may require an industrial proponent, planning to undertake an operation likely to result in the deposit of waste into arctic waters, to submit work plans for review. Unbridled by pre-established procedures or a legislative requirement for public review, the Minister of DIAND may approve, modify or reject a project.

The Department of Fisheries and Oceans (DFO), pursuant to the Fisheries Act (section 33.1), may require a project, likely to disrupt fish habitat or to deposit a deleterious substance into waters frequented by fish, to undergo an extensive environmental review. Subject to Cabinet approval, the Minister of DFO may by order modify, restrict or close down an proposed undertaking. Although Cabinet is empowered to impose regulations to govern the review process, for example, providing for a limited time-frame and public consultation, to date no such procedural regulations have been passed.

The Department of Environment, through an independent office, the Federal Environmental Assessment Review Office (FEARO), may subject federal related projects, having a significant potential to impact the environment, to an environmental assessment review process (EARP). An environmental assessment panel would require the project proponent to prepare an environmental impact statement and to undergo a public review. Panel recommendations, however, are not binding and implementation would depend on ministerial approval.

The National Energy Board, a quasi-judicial board associated with the Department of Energy, Mines and Resources (EMR), also possesses a legal lever for examining environmental implications of shipping associated with oil and gas development. The Board may require technical and environmental studies as a precondition to granting an export license for oil or gas transported from the Canadian offshore to foreign markets.

The Canadian Oil and Gas Lands Administration (COGLA), delegated powers over offshore oil and gas development by the Minister of DIAND (for North of 6090) and by the Minister of EMR (for South of 6090) may also affect the pace and conditions of offshore development through various approval requirements such as exploration agreements, drilling program approvals and an authority to drill.

If a project involves construction of a marine terminal, a non-legislated TERMPOL review process may apply. If an interdepartmental TERMPOL Coordinating Committee believes a proposed terminal may have an adverse environmental impact, the Committee could ask a project proponent to undergo an extensive review, including preparation of an environmental impact statement and various studies such as vessel traffic projections, navigational conditions and underkeel clearances in the site area.

A further administrative mechanism–land-use planning–may also soon apply to offshore arctic areas; but how the process will relate to shipping activities remains uncertain.

Shipping Management:

Canada manages northern shipping activities through three major mechanisms–the Arctic Waters Pollution Prevention Act (AWPPA), the Canada Shipping Act and a voluntary vessel traffic management system called NORDREG. The Arctic Waters Pollution Prevention Act is the great bulwark for government regulatory power and in four ways seeks to curtail vessel source pollution in a 100 nautical mile zone adjacent to the arctic mainland and islands. First, the Act prohibits all waste disposals from ships into arctic waters with the minor exceptions of human and animal wastes generated aboard and oil if necessary to save life or the ship itself. Second, the Act imposes special vessel equipment requirements, for example, gyro-compasses, marine radar and echo sounding devices, and special manning requirements such as two deck watches and an ice navigator. Third, the Act establishes 16 shipping safety zones (see Figure 1 and 2) wherein 14 classes of vessel are restricted in movement according to ice conditions and vessel design and construction. The zones were established on the basis of best-available ice information in 1972. Several amendments have been made, while others are still pending review. Only an Arctic Class 10 ship would be permitted to operate year-round in all sixteen zones. Operational limitations imposed in zones 6 and 13 (Parry Channel and Lancaster Sound) are the most contentious from industry's perspective since shipping is prohibited between November 15 and June 25 (zone 13) and between November 20 and August 15 (zone 6) for existing Class 2 ships such as the *M.V. Arctic.*

A fourth method for pollution prevention is through pollution prevention officers. Pollution prevention officers are given broad powers to inspect ships when in a safety zone and to order a ship to move outside or to remain outside a zone because of not meeting standards or because weather, visibility, ice, sea conditions or the nature of the cargo justify an order in "the interests of safety". The language "in the interests of safety" seems to imply the power to prevent marine accidents and does not seem to be broad enough to empower an officer to control vessel entries to prevent encroachment into ecologically sensitive areas.

The Canada Shipping Act controls shipping activities between 100 and 200 nautical miles offshore through two major sets of regulations. Oil Pollution Prevention Regulations prohibit the disposal of oil and oily mixtures into marine waters while the Pollutant Substances Regulations prohibit the discharge of approximately 400 other pollutants such as mercury, arsenic and cyanide compounds.

The Arctic Canada Traffic System (NORDREG) is a voluntary vessel traffic system intended to provide information and assistance to arctic ship operators. Marine traffic regulators, stationed at Frobisher Bay, N.W.T., may provide information or advice to ships, request information, issue marine traffic instructions and issue a traffic clearance. Traffic clearances are requested 24 hours in advance of entering the arctic traffic zone and not less than one hour before a ship intends to depart from the zone. The 1984 Beaufort Sea Environmental Assessment and Review Panel report recommended that NORDREG should become a mandatory rather than voluntary system to enhance control of shipping and to further assure arctic marine environmental protection. Amendments to the Canada Shipping Act to provide for a national system of vessel traffic services are presently under Parliamentary review.

To facilitate planning and consultation on vessel routeing and environmental issues in arctic waters, two additional administrative mechanisms have been established upon recommendation by the Environmental Assessment Review Panel for the Arctic Pilot Project. The Arctic Shipping Control Authority, consisting of the Commissioner and Deputy Commissioners of the Coast Guard and appropriate Coast Guard Directors, is an institutional mechanism for formulating a feasible traffic management system for arctic waters including all of Hudson, James and Ungava Bays. The Environmental Advisory Committee on Arctic Marine Transportation

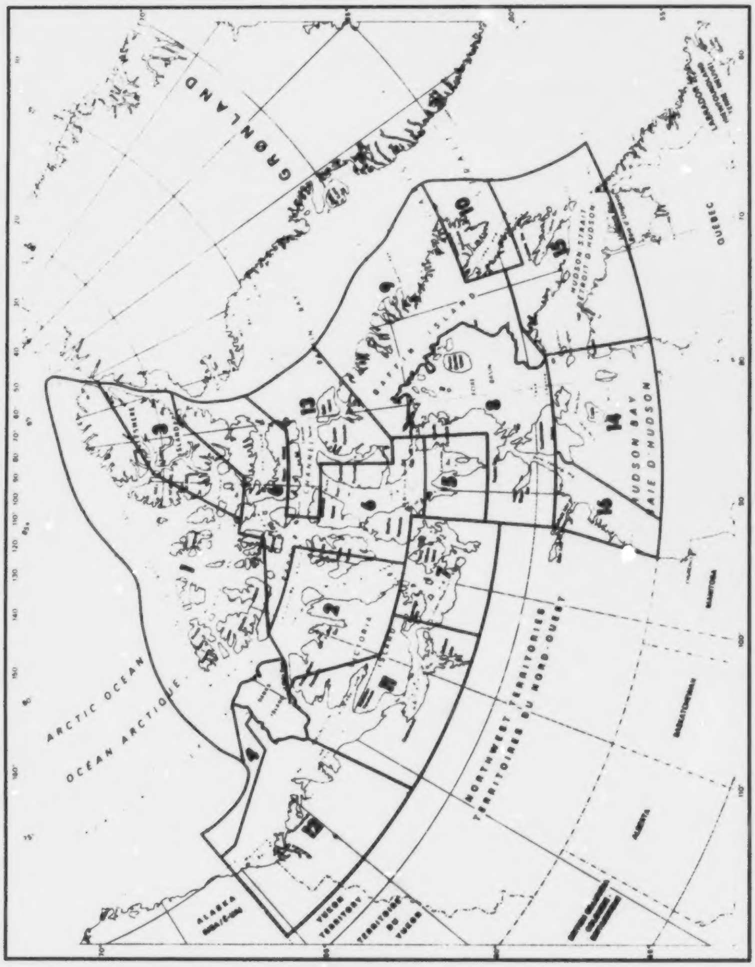

Figure 1 Shipping Safety Control Zones

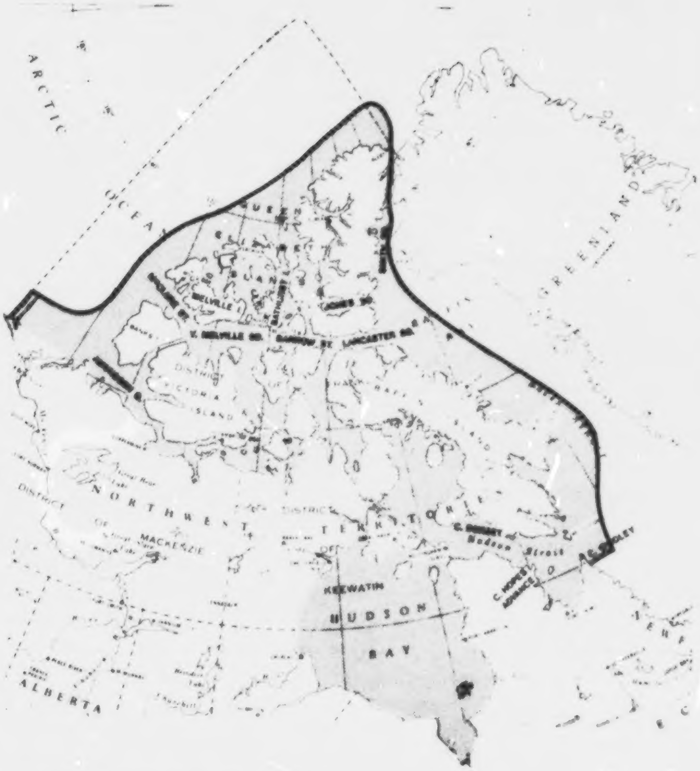

Figure 2 Arctic Canada Traffic Zones

(EACAMT), consisting of representatives from the Territorial governments,DIAND, the Department of National Defence, the Department of Energy Mines and Resources, industry, Northern residents, and the Director of Coast Guard Northern (ex-officio member), is jointly chaired by representatives from the Departments of Environment and Fisheries and Oceans (who are also ex-officio members of the Control Authority) and serves two functions. The Committee not only provides a consultation forum for informing other departments and parties of proposed shipping activities but also provides an advisory function by recommending environmental research and measures necessary to protect the environment.

To facilitate consultation and advice over vessel routeing and environmental protection out of 60° particularly off the coast of Labrador, an Environmental Advisory Committee on Newfoundland and Labrador Marine Transportation, was established in 1984 at the urging of the Labrador Inuit Association.

International Legal Regime

The extent of a coastal state's ability to restrict offshore vessel transits in order to protect the marine environment is not up to a national whim but limited by the reins of international law, a law which is very uncertain in the Arctic. In the ocean area beyond 200 nautical miles from territorial sea baselines, two major possibilities exist for jurisdictional status. First, the area could be considered part of the high seas where "freedom of the seas" would apply and each nation would be free to impose shipping restrictions on its own flag vessels subject only to minimal requirements of international law. Article 94 of the Law of the Sea Convention requires states to follow generally accepted international standards to assure flag vessels plying the high seas are safe through such measures as appropriate surveying of ships, provision of nautical publications and navigational equipment and appropriate qualifications of masters, officers and crew. Vessels might also be subject to international conventions, such as MARPOL 73/78, if the flag state were a party to such conventions. MARPOL, short for the International Convention for the Prevention of Pollution from Ships adopted by the International Conference on Maritime Pollution in 1973 (and amended in 1978), requires special vessel construction, such as segregated oil and water ballast tanks, and establishes strict oil discharge limits. For example, an oil tanker could only discharge oil if proceeding en route more than 50 nautical miles from the nearest land and at a rate not exceeding 60 litres per nautical mile. Total oil discharged by existing ships could not exceed 1/15,000 of the total original cargo (1/30,000 for new tankers).

Second, the Arctic Ocean area beyond 200 nautical miles could be considered *sui generis* that is, a unique ice-covered area not subject to traditional law of the sea but requiring a specialized legal regime. The legal door would remain open for coastal states and interested maritime states to reach special agreement on an appropriate legal framework covering such aspects as vessel design and discharge limitations.

For arctic exclusive economic zones (EEZs), the ocean areas beyond a nation's territorial sea and out to 200 nautical miles, Article 234 of the Law of the Sea Convention provides special regulatory powers to coastal states to protect the marine environment from vessel source pollution:

> Coastal States have the right to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and control of marine pollution from vessels in ice-covered areas within the limits of the exclusive economic zone, where particularly severe climatic conditions and the presence of ice covering such areas for most of the year create obstruction or exceptional hazards to navigation, and pollution of the marine environment could cause major harm to or irreversible disturbance of ecological balance. Such laws and regulations shall have due regard to navigation and the protection and preservation of the marine environment based on the best available scientific evidence

Three major questions lurk within the language. First, how broad is coastal state regulatory power to restrict vessel transits in the EEZ? At one extreme is a broad geographical interpretation favouring coastal states. Once the geographical requirement of "ice-covered waters for most of the year" is established, a coastal state would be free to pass almost any pollution prevention laws, even stringent regulations governing vessel design and crewing of all types of vessels including commercial submarines and oil tankers during ice-free months and vessels carrying non-hazardous cargoes. The outer limit of such power might be the inability to altogether prohibit vessel traffic in arctic waters for Article 234 requires regulations to "have due regard to navigation" (McRae and Goundrey,1982).

At the other extreme is a narrow "territorial sea" interpretation favouring shipping states. Since Article 234 by express language limits coverage to the EEZ, and not the territorial sea, the implication is that a state would have no greater power to control shipping in the EEZ than in the territorial sea. The territorial sea regime limits a coastal state from unilaterally regulating vessel design, construction, equipment and manning of foreign ships and prevents a state from interfering with innocent passage.

An in-between position is a narrow "when" interpretation of Article 234. The Article grants broad regulatory rein to coastal states only *when* three conditions are present: when climatic conditions are severe, when ice creates an exceptional hazard to navigation and when pollution could cause major ecological harm (McRae and Goundrey,1982).

A second question left open by Article 234 is the geographical extent of ice-covered waters. How is "ice-covered for most of the year" to be defined? Does ice-covered mean 100 per cent coverage, 90 per cent coverage or perhaps any amount over 50 per cent? Is most of the year to be determined by a single heavy ice year or by an average of ice years?

A third question is what is the relevant definition of marine pollution? Does the word pollution include noise interference with marine mammals? A report on behalf of the Committee on the Environment, Public Health and Consumer Protection of the European Parliament has indicated that Article 234 may be interpreted to cover noise with harmful environmental effects (European Parliament,1983).

Legal questions also arise over coastal state powers in the territorial sea. Does Article 234, the ice-covered waters provision, apply to the territorial sea and allow coastal states to go beyond usual territorial sea powers to regulate vessel design, construction, equipment and crewing of foreign vessels? The regular territorial sea regime prohibits a coastal state from interfering with innocent passage of foreign ships, but how is innocent passage to be defined? Is transit of an oil tanker innocent passage? If the 1958 Convention on the Territorial Sea represents customary international law the answer is particularly unclear for the Convention provides only a wide-open formula: "Passage is innocent so long as it is not prejudicial to the peace, good order and security of the coastal state". The new Law of the Sea Convention, meanwhile, in Article 19 provides a detailed list of what is not innocent which indicates transit of a laden oil tanker would be innocent so long as no act of "wilful and serious pollution" occurred.

An especially sensitive international issue brews over the Northwest Passage. The US has claimed the Passage is an international strait subject to the right of transit passage where a coastal state would only retain minimal regulatory powers such as the right to prohibit foreign fishing and the right to control the discharge of oil and other noxious substances in conformity with international standards. Canadian officials have on occasion claimed the waters of the Passage as internal subject to complete coastal state control including the right to prohibit vessel traffic.

Regardless of legal uncertainties in the various functional zones of arctic waters, the Law of the Sea Convention does provide coastal states with broad power to impose vessel traffic systems (VTS). For internal waters, Article 211(3) would justify imposition of a vessel traffic management system and the requirements would merely have to be communicated to the competent international organization which is likely the International Maritime Organization (IMO). For the territorial sea, article 22 allows a coastal state to impose sealanes and traffic separation schemes but the coastal state must take into account the recommendations of the competent international organization. For ice-covered areas of an exclusive economic zone, Article 234 would seem to provide ample power for a coastal state to implement a traffic management system (Gold,1984), but the role of IMO remains uncertain. For international straits, Article 41 allows a coastal state to impose sealanes and traffic separation schemes after referral to the competent international organization with a view to adoption.

Future Options

To assure arctic shipping and associated major projects are compatible with the marine environment, arctic states such as Canada will have to take new directions in developing ocean law and policy at both the national and international level.

National:

Because protection of the marine environment is not an objective phenomenon but involves a subjective balancing of competing ocean uses – shipping, oil and gas development, renewable resource harvesting, recreation and special areas conservation–a legal system is challenged to assure a framework where all political voices may be equally heard and equally weighed.

To an extent the fragmented nature of the Canadian decision-making process for resource management reflects the political reality. Individual departments and agencies have been established to represent divergent interests, for example, Transport Canada/Coast Guard (marine transportation), COGLA (oil and gas development), the Department of Fisheries and Oceans (renewable resource harvesting and marine environmental quality), DIAND (northern resource development and environmental protection), and the Department of Environment (environmental conservation and special areas designation). The end result tends to be a creative negotiation and bargaining process of decision making.

In the case of the arctic offshore a central political interest is native cultural dependence on sea ice and marine mammals which the Canadian government has made a strong effort to accommodate. The Lancaster Sound Regional Study, Environmental Assessment Reviews for the Arctic Pilot Project and Beaufort, and the evolving land-use planning process all reflect attempts to consider the marine environment and Northern interests.

To some extent, however, environmental interests have played against a stacked legal deck, for the present legal regime is largely lacking in procedural rights and substantive decision-making powers for Northerners. For example, the Fisheries Act and Arctic Waters Pollution Prevention Act do not guarantee public inputs into the decision-making process though such requirements as public notice of reviews, public consultation or public hearings. At present the Environment Advisory Committee on Arctic

Marine Transportation operates without clear procedural guidelines, without independent funding, and without a requirement for dissemination of information to the public. Existing and planned decision-making arrangements leave Northerners with largely an advisory role. For example, the land-use planning process as presently formulated would leave decision-making authority with the Ministers of DIAND and Renewable Resources of the Northwest Territories who would have to provide reasons for decisions contrary to land-use plans.

To fine-tune the national decision-making process for arctic offshore uses, Canada might look in two directions. First, clear procedures for governmental reviews, under such Acts as the Fisheries Act and Arctic Waters Pollution Prevention Act, should be provided in regulations. Second, a greater role for Northerners in ocean management decisions might emanate from land claims negotiations and political evolution of the Territories, perhaps through the vehicle of land-use planning. Two models in particular offer a guiding light for assuring Northern aspirations are given due weight. A coastal zone management approach along the lines of the US Coastal Zone Management Act, 16 USC.A. sections 1451-1464, might be adopted to balance federal, territorial and local interests in the offshore by providing for sea ice/coastal management plans. Federal agency activities would have to the maximum extent possible be consistent with such plans and no federal permits could be granted until the Territory concurred (unless necessary in the interest of national security). The recent Atlantic Accord between Newfoundland and the Canadian Government for cooperatively managing offshore oil and gas development also offers a model. The Accord establishes a 7 member Board, with equal federal and provincial representation, having decision-making powers over such factors as production licenses, including the exclusions of lands from a production license, and administration of regulations governing environmental protection. As suggested by the recent Task Force on Northern conservation, northern land-use planning should become a legislated process (Task Force on Northern Conservation,1984).

The national regime for vessel traffic management might also be strengthened. The present Canadian vessel traffic system for the North, NORDREG, will likely become mandatory in the near future, but at least three further provisions should be assured. Provision should be made for designation of special ecological areas which vessels would either be required to avoid or be subject to special requirements such as speed/noise levels, timing of transits and recommended routes. Clarification should be provided concerning the relationship between land-use planning and vessel traffic management. Perhaps the land-use planning process might be a mechanism for assisting in the designation of ecologically sensitive areas. Lastly, the Canadian government should commit itself to implementing a comprehensive environmental protection system such as

REMSCAN where ice and environmental surveillance data would be integrated into an expanded NORDREG traffic management system.

Implementation of traffic separation schemes, a strict form of routeing where ships would be subject to one way traffic lanes divided by a separation zone, seems unlikely in Canadian arctic waters at least in the near future. Such schemes tend to be used in areas of high traffic density. For example, on the Pacific coast of North America only four IMO adopted traffic separation schemes exist–off San Francisco, in the Santa Barbara Channel, in approaches to Los Angeles–Long Beach, and in the Strait of Juan de Fuca (International Maritime Organization,1984). On the Atlantic coast of North America eight IMO approved schemes exist including the approach to Boston, Massachusetts, the approach to Portland Maine and off New York (International Maritime Organization,1984). IMO guidelines note that routeing systems such as traffic separation schemes may not be appropriate for heavy ice-covered waters:

> Routeing systems are intended for use by day and by night in all weathers, in ice-free waters or under light ice conditions where no extraordinary manoeuvres or assistance by ice-breakers(s) are required (International Maritime Organization,1984).

If vessel traffic eventually reaches a high density in arctic waters, consideration might be given to separation schemes for particularly narrow or special navigational areas such as Barrow Strait and Prince of Wales Strait.

International:

Present international mechanisms for marine environmental protection in the Arctic are minimal. The only region-wide agreement is the Convention on the Conservation of Polar Bears. Canada has entered into only two functionally limited bilateral agreements for environmental protection. Canada and the United States, through a Joint Marine Pollution Contingency Plan, have agreed to cooperate in responding to pollution incidents with transboundary implications in the Beaufort Sea. Canada and Greenland/Denmark, through a Marine Environment Cooperation Agreement, have agreed to establish joint contingency plans for shipping or seabed pollution incidents and to cooperate in vessel traffic management and in identifying appropriate vessel routeing areas.

The Law of the Sea Convention beckons states to take new cooperative initiatives in protecting the marine environment. Article 194 requires states to harmonize their policies to prevent and control pollution from any source and requires states to take measures to protect rare or fragile ecosystems and habitat of threatened species. Article 211 requires states, acting through the competent international organization or general diplomatic conference, to establish international rules for reducing vessel-source pollution and to promote routeing systems for minimizing the threat of accidents. Article 123 bids states bordering semi-enclosed seas to coordinate rights and duties with respect to protection and preservation of the marine environment. The Arctic Ocean appears to fit the convention's definition of a semi-enclosed sea for the Ocean consists primarily of territorial seas and exclusive economic zones of two or more coastal states.

For arctic shipping, numerous areas exist where international cooperation could be advantageous. For example, oilspill clean-up techniques and trajectory models might be compared and a regional arctic contingency plan might be developed. National requirements for vessel design, construction and equipment might be made uniform to facilitate region-wide polar transits. Cooperative training programs and standards for arctic crewing might be established. Cooperation in studying marine mammal distributions, responses to noise and habitat requirements might be formalized, for some marine mammals do not recognize national boundaries. For example, bowhead and beluga whales are known to migrate through the Beaufort, Chukchi and Bering Seas (Fraser,1979). Northern communication and navigation systems, often dependent on satellites owned by other nations, might be coordinated, to avoid duplication in expensive technologies and to assure access. Approaches to vessel routeing and designation of special areas might be coordinated and adopted by IMO, the specialized agency of the United Nations responsible for maritime safety and efficiency of navigation. IMO has already designated a number of "Areas to be Avoided" by certain ships for environmental protection reasons including Nantucket Shoals, the Northwest Hawaiian Islands, and the Great Barrier Reef (International Maritime Organization,1984). A legal regime for vessels beyond 200 nautical miles in arctic waters might be discussed including appropriate discharge standards. The scope of coastal state jurisdiction over ice-covered waters of the EEZ, territorial sea and arctic straits might also be clarified.

Increased international cooperation in the Arctic might occur at various levels. For example, Canada might wish to clarify the status of the Northwest Passage through a series of bilateral agreements which would grant foreign navigation access in return for recognition of Canadian sovereignty and corresponding environmental management rights. Since the Beaufort Sea is a closely shared region of ocean space, Canada and the United States might negotiate a Beaufort Marine Cooperation Agreement establishing a formal Beaufort Marine advisory Committee to advise on all bilateral issues of offshore development including vessel traffic management, marine scientific research, habitat protection and environmental monitoring (VanderZwaag and Lamson,1984). Canada, the United States and the Soviet Union might enter into a trilateral marine mammal cooperation agreement focusing on research and protection of bowheads and belugas which migrate through the waters of all three countries. A comprehensive approach to managing arctic shipping might be accomplished through a multilateral Arctic Shipping Convention forged under the auspices of IMO and balancing the interests of Arctic littoral states and interested maritime states.

Such a Convention might be part of a larger cooperative package of agreements developed through the assistance of UNEP's Regional Seas Programme. An overall Regional Action Plan might be developed for arctic marine waters and cover, in addition to vessel source pollution, such issues of land-based pollution, atmospheric pollution, marine scientific cooperation, and living resources protection.

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Coastal and Marine Area Management in the Arctic

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Introduction

Coastal and marine areas, together with their associated natural resources, have long been disproportionately important in the Arctic.* Traditional nomadic Inuit (Inupiat)** depended largely on marine fish, mammals and birds for subsistence and engaged in coastwise trading of surpluses (Sugden, 1982). Early European contacts were also mostly restricted to coastal locations. Today, permanent native settlements are overwhelmingly coastal in North America, Greenland, Norway and, to a lesser extent, the Soviet Union. Throughout the Arctic, commercial fishing ports, mines, oil and gas wells, and associated infrastructure are generally sited near coastlines or in adjacent offshore waters. Hence, coasts are increasingly foci of conflicts about environmental conservation and development. Indeed, it can be argued that coasts and marine areas are inextricably bound up with all of the major contemporary Arctic issues: native rights; future economic development; environmental degradation; international boundary disputes; and new governmental institutions (Dacks, 1984). How governments choose to influence the use of arctic coastal and marine areas will, to a large degree, determine how the nature of arctic society evolves. Any attempt to formalize management of these areas goes to the heart of arctic affairs.

It is suggested that arctic coastal and marine areas constitute an interacting natural system that extends from the inland margins of maritime watershed to, at least, the outer edge of the Exclusive Economic Zone (200 nautical miles) (Sorensen *et al.*, 1984). Ideally, public policies should recognize the integrity of this system and strive to create integrated management programs that can resolve conflicts among competing users, and reduce - or eliminate - negative societal and environmental impacts. This involves accommodating the concerns of many affected interest groups and several levels of government.

The International Union for the Conservation of Nature and Natural Resources (IUCN) has recently published management guidelines for arctic coasts and marine areas, but no comprehensive international program has yet been adopted (Salm and Clark, 1984). Despite formidable political obstacles that would face any attempt to create a UNEP sponsored Arctic Regional Seas agreement among the superpowers, it has also been suggested that the time may be ripe for such an initiative (Nelson and Needham, 1985). No arctic nation possesses a totally integrated management program that orchestrates all sectors of human activity in both the marine and terrestrial environments and the five littoral states (i.e. USA; Canada; Greenland (Denmark); Norway; USSR) appear to follow different strategies. Using Alaska's North Slope and the Canadian Arctic as examples of complex management systems, this paper reviews problems of coastal and marine management, and suggests direction for improving related public policies throughout the Arctic

Any analysis of coastal and marine management in arctic regions of Alaska must take account of profound changes that have affected the area during the past 20 years. These include: (1) major oil and gas discoveries (1968); (2) passage of the National Environmental Policy Act (NEPA 1970); (3) adoption of the Alaskan Native Land Claims Settlement Act (1971); and (4) the Organization of Petroleum Exporting Countries (OPEC) oil embargo (1973). Prudhoe Bay's oil strike demonstrated the existence of valuable resources comparable to the largest Mid-East fields. NEPA required that extraction and transportion of oil could take place only after detailed Environmental Impact Statements had been formulated and evaluated. The Land Claims Act ensured that Inupiat populations, which had long been denied a significant voice in local affairs, would be deeply involved in management decisions about natural resources found on their lands. Events such as the OPEC embargo, accompanying price increases and arctic hydrocarbons competitive with supplies from other regions stimulated further exploration in difficult environments like the North Slope and the Beaufort Sea. Such events also accelerated fundamental environmental, economic and social changes among Inupiat who had heretofore occupied the most remote and unspoiled wilderness areas in the United States. Since formal North Slope coastal and marine management programs did not begin until 1976 and 1979 respectively, they are relative newcomers to the arctic scene.

The United States possesses two separate systems of management for coastal and marine areas. One is predominantly federal, fragmented among many agencies with sectoral responsibilities, and oriented primarily to marine resource development. The other is predominantly administered by state and local governments, coordinated by single state agencies, with broad responsibilities for integrated planning and management, and dedicated to achieving balanced use of onshore environments amid diverse competing demands.

Coastal Management

So far as is known, the United States is the only nation that uses a formal coastal management program to regulate a significant portion of arctic territory (Mitchell, 1982; Sorensen *et al.*, 1984). It is based on the US Coastal Zone Management Act of 1972 and succeeding amendments. This legislation attempts to balance or resolve competing demands for coastal resources by creating management systems that are both tailored to the needs of different regions, and consistent with national coastal policy. These goals are sought through a federal-state partnership wherein Washington retains responsibility for general policy, funding and review, but individual states develop plans and implementation measures.

With the exception of Ohio, Indiana, Illinois, Minnesota, Georgia and Texas, all US states and territories have adopted management programs for coastal lands and adjacent territorial waters. These are administered by the US Office of Ocean and Coastal Resources Management (OCRM) through lead state agencies. They aim to integrate economic development and conservation objectives and to "network" existing governmental programs to produce multi-purpose coastal use strategies. Unlike marine area management, which frequently involves the use of scientific principles for resource conservation, scientists are only one among many coastal management interest groups. Coastal management emphasizes resource allocation, tradeoffs, bargaining, conflict resolution, compromise and other techniques or skills of a political and administrative nature.

Offshore oil and gas activities pose special problems for onshore areas (Mitchell, 1976; Mitchell, 1978). Under Section 308 (a) (1) of the Coastal Zone Management Act, states that suffer problems can draw financial assistance from the Coastal Energy Impact Program. The amount that any one state receives varies in approximate proportion to the degree of offshore oil and gas activity that takes place in adjacent waters.

The equitable sharing of OCS oil and gas revenues among state and federal governments is a contentious subject. In addition, the present US administration has made strong efforts to devolve coastal management responsibilities entirely to state governments. To date this has not occurred because legislators continue to support and fund the program. However, the Coastal Zone Management Act requires reauthorization in 1985 and a heated debate is anticipated.

As an outgrowth of federal initiatives, the Alaska Coastal Management Act was passed in 1977 and a state coastal management program was approved in July 1979. The major issues that it addresses concern development and conservation of primary natural resources, especially oil and gas fields, hard minerals, forests, fish and wetlands. Inasmuch as large scale economic development is bringing twentieth century society into contact with subsistence native populations and wilderness areas, there is major potential for human and environmental conflicts throughout the state's coastal zone.

Alaska's coastal management program lays down standards and guidelines to be followed by local governments that are responsible for developing district coastal management programs. These criteria include preparation of resource inventories and resource analyses together with lists of uses subject to possible regulation. Although local governments have primary authority to formulate and enforce coastal management programs, the state retains strong powers to alter district decisions where they unduly restrict or exclude specific "Uses of State Concern". Such uses include many of the major economic development activities. Moreover, although the state recognizes that subsistence usage of coastal areas deserves special protection, municipalities are cautioned not to use subsistence area designations to block economic development activities.

The North Slope: Depending on the boundary criteria selected, all or most of Alaska's arctic coast falls within the North Slope Borough (Figure 1). The Borough was organized in 1972 as a consequence of the Alaska Native Claims Settlement Act (1971). It is the largest municipality in the United States and covers approximately 227, 920 square kilometres. Only about 7 per cent of this land is owned by the eight Native Village Corporations and the Alaska Slope Regional Corporation. These semi-private property holdings are concentrated in two areas: (1) between the Colville and Canning Rivers, south of the Beaufort Sea (Prudhoe Bay), and (2) along the Chukchi Sea at the western end of the Borough, between Point Lay and Point Hope. All other lands are either federal property (e.g. Naval Petroleum Reserve-Alaska; Arctic National Wildlife Refuge; Noatak National Reserve) or state property (1.42 million hectares).

Large scale arctic resource development schemes have been characterized by successive cycles of exploitation and abandonment. Although some researchers have suggested that northern Alaska might be used as a site for perpetual storage of radioactive wastes (Libby *et al.* 1982), energy development is now the main focus of public concern in the North Slope Borough. Since 1968 the original oil discoveries have been augmented by significant later finds (US National Petroleum Council, 1984). As a result the Inupiat population of 4, 199 (1980) (US Department of the Interior, 1984) has been joined by 6, 306 oilfield workers (US Department of the Interior, 1984) from southern Alaska and elsewhere. All but one of the native villages lie on, or close to, coasts. Oilfield operations are concentrated in an enclave near the Beaufort Sea between the Kuparuk and Sagavenirktok (Sag) Rivers. This area is 80 kilometres from the nearest Sinupiat village but exploration, production, transportation and support activities take place on lands and waters traditionally hunted by native

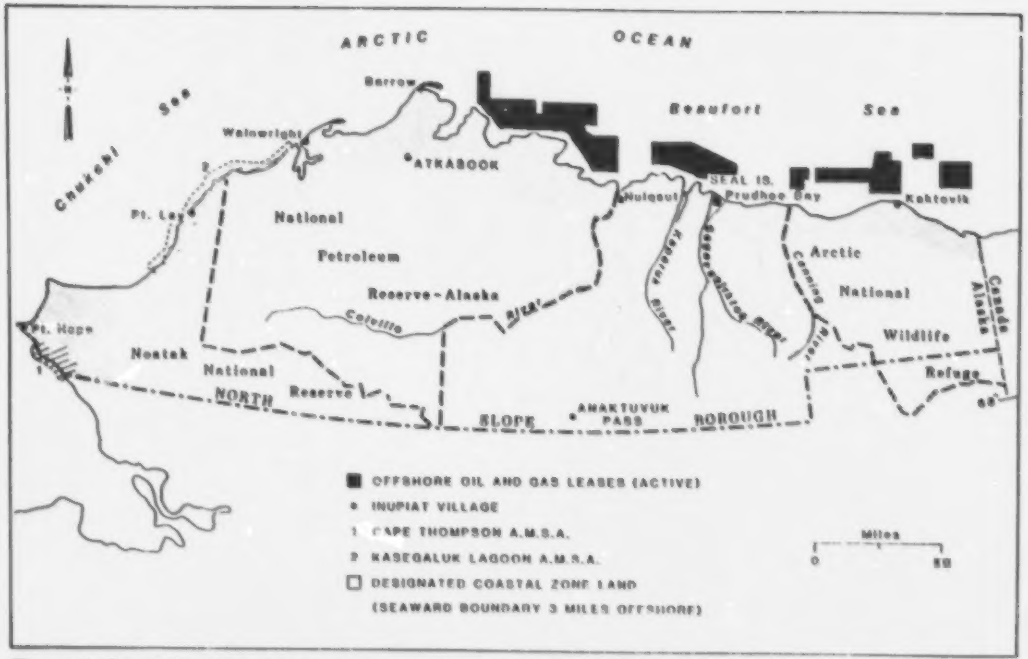

Figure 1 Coastal and Marine Management Districts on Alaska's North Slope.

groups. Moreover, offshore lease sales have included submerged lands adjacent the entire native-owned coast between the Colville and Canning Rivers.

It is well to remember that the US Coastal Zone Management Act was not framed with arctic coasts in mind. It was designed for scientifically understood, mid-latitude coasts occupied by multiple competing interest groups, well skilled in the procedures of modern bureaucracy. On the North Slope's ice covered shores it is often difficult to tell where land ends and the ocean begins. Much of the coast is entirely unpopulated and scientific information is limited. Some coastal management initiatives that are appropriate in the "lower 48" states, are misplaced or irrelevant in the Arctic (e.g. access to public beaches; urban waterfront and port redevelopment). Moreover, individual native inhabitants of the North Slope are still learning to operate within a modern bureaucracy and are working out their relationships with other external groups. The Borough as a whole continues to test the limits of its recently acquired authority vis a vis state and federal governments. Hence, coastal zone management must be viewed as a tentative and continually evolving process in arctic Alaska.

From the outset, North Slope Inupiat welcomed coastal zone management as an aid to their campaign for increased local self-determination. A great variety of oil and gas development issues and related problems of wildlife management were gathered under the nascent banner of coastal zone management. They included: (1) opposition to Canadian Offshore Continental Shelf (OCS) exploration; (2) international policy for the protection of the Arctic; (3) creation of alliances between Inupiat and outside environmentalists; (4) changes in caribou management and duck hunting regulations; and (5) claims in support of extending "aboriginal offshore jurisdiction" over natural resources found beyond the state's 5 kilometre limit (US Bureau of Land Management, 1978).

The first attempt to define an "Arctic Coastal Zone Management Program" began in 1976, before the state of Alaska had adopted its own Coastal Management Act. The initial coastal management strategy focussed on four separate areas; Prudhoe Bay; Naval Petroleum Reserve; Arctic National Wildlife Refuge; and Point Hope/Point Lay. Because development pressures were most severe in Prudhoe Bay, a management program for that sector was completed in 1978. Together with a supporting permit system and interim zoning regulations, a coastal management ordinance was approved by the North Slope Borough Assembly in October 1979. This was a highly controversial action whose detractors claimed that it arbitrarily placed much land off limits to industrial use and asserted regulatory authority that lacked legal foundation. Soon thereafter, a combination of strong oil and gas industry opposition, critical reviews by state agencies, and the prospect of major litigation, persuaded the Borough to withdraw the Prudhoe Bay (Mid-Beaufort) Coastal Management

Program before it was reviewed by the Alaska Coastal Policy Council (10 January 1980).

In late 1980 a fresh start was made on both a comprehensive land use plan and a coastal management program for the North Slope Borough. This time it was decided to identify issues and draw up policy guidelines for the entire coast rather than a specific sector. The "Concept Approved" document was adopted by the Borough in February 1984 and the entire management program is currently awaiting approval by the state of Alaska.

The new proposed North Slope coastal management zone covers approximately 51, 800 square kilometres and in a broad band from 5 kilometres to 40 kilometres inland. Several narrow river corridors that penetrate 240 kilometres further upstream into the Brooks Range are also included (Figure 1). Many US state coastal management programs use natural ecosystem criteria to delimit their landward margins, but the North Slope program goes further than this by including lands and waters that support animal populations which migrate periodically between the ocean and distant inland sites. Indeed, protection of renewable resources that are of primary concern to local native populations is the principle on which this coastal management program rests. Human activities that threaten anadromous fish (e.g. arctic char), marine mammals (e.g. bowhead whales), seabirds (e.g. murres), and upland mammals (e.g. caribou), are subject to regulation. Amongst others, such activities include: oil and gas developments, gravel mining, water withdrawals, and the emplacement of structures near wildlife habitats. Though state and environmental statutes or regulations are mentioned as a basis for structuring the North Slope program, it is clear that much greater importance is attached to locally inspired policies for (1) maintaining subsistence resources at or above the level of native needs; (2) safeguarding the integrity of traditional activities; and (3) securing cultural and historic sites.

In addition to general regulations, two parts of the North Slope coast are designated as Areas Meriting Special Attention (AMSA) because they possess unique ecological, cultural or other resources that deserve exceptionally careful management. The Cape Thompson Candidate AMSA contains 56 kilometres of predominantly cliffed coastline. It hosts large numbers of murres, kittiwakes, cormorants, puffins and other seabirds that form an important subsistence food resource for Point Hope villagers. Kasequluk Lagoon Candidate AMSA extends for 224 kilometres along the oceanfront within - and west of - the Naval Petroleum Reserve. It contains numerous barrier islands and lagoons, estuaries, wetlands and tidal flats. These features support rich stocks of spotted seals and beluga whales as well as extensive populations of waterfowl, marine and anadromous fish. Both AMSAs lie in the western portion of the Borough, far removed from existing industrial activities, but they are adjacent to proposed offshore oil and gas lease tracts and exploration has already occurred near Kasequluk Lagoon.

Other North Slope Borough Management Activities:

Coastal zone management is only one of three major North Slope Borough land use and facilities regulation activities. Using revenues obtained by taxing onshore oil operators, the Borough has financed an ambitious Capital Improvements Program. It is believed, by some, that the CIP has been responsible for more far-reaching social and environmental changes than oil and gas operations. The Borough builds and upgrades housing; installs water and power services; constructs roads, airstrips, port terminals; erects schools, community centers and public buildings; provides public health and social welfare systems; and creates jobs for local residents. For example, in a two year period (1975-77) almost $152 million were spent on these purposes. As a result, levels of living have risen substantially and the comparative purchasing power of North Slope residents is about 77 per cent that of US citizens nationally.

The North Slope Borough Plan and Land Management Regulations constitute a third major local regulatory activity. The Plan became effective on 1 January 1983. It is designed around an Automated Geographic Information System and is intended to preserve ecosystems essential to subsistence living and traditional activities. Insofar as oil development tax revenues provide the basis for Borough wealth, non-renewable resource development is accommodated within the plan. Four types of zoning districts are identified (Villages, Barrow, conservation, and resource development). Normally, oil and gas or other industrial activities are allocated to separate requirements for the preparation of development Master Plans or the award of development permits.

Bitter battles have erupted over oil and gas activities. They constitute the main onshore and offshore economic activity in arctic Alaska. Existing North Slope production is located entirely onshore and is subject to the provisions of local zoning and coastal zone management regulations (see above). The resource development districts include: oil wells, gathering lines, pumping plants, roads, water injection wells, storage tanks, supply bases, docks, airstrips, residential and administrative complexes. The Trans-Alaska Oil Pipeline and the Haul Road, provide overland transportation links to southern Alaska.

Environmental interest groups in the "lower 48" states and elsewhere currently oppose leasing exploration tracts within the Arctic National Wildlife Refuge and the state of Alaska has previously lodged formal opposition to lease sales within the Naval Petroleum Reserve on the grounds of non-compliance with Alaska's coastal management program. Given the significant extent to which projected onshore exploration is scheduled to intrude on native hunting lands, the North Slope Borough has also frequently opposed aspects of hydrocarbon exploration and development. However, most concern centers on offshore petroleum activities.

Marine Area Management

In the United States, fish, mammals, birds, oil and gas, and other deep water resources that lie beyond the three offshore state territorial limits, are each separately managed sectors of activity. Basic legislation (e.g. Outer Continental Shelf Lands Act) emphasizes single purpose uses of marine resources (e.g. oil and gas exploitation). Separate federal agencies have jurisdiction over different types of resources (e.g. National Marine Fisheries Service, Fish and Wildlife Service, Minerals Management Service). Natural science principles and data help to structure agencies, in turn, provide major funding for research on the marine environment. The result is a patchwork of incomplete and sometimes mutually conflicting public policies wherein most government bodies are strongly concerned with resource exploitation and economic development, while some practice conservation and resource protection measures. The nation possesses separate fisheries management plans, endangered species programs, offshore oil and gas programs and other marine management activities, often further fragmented into regional or area wide strategies.

Various attempts have been made to reform and coordinate this fragmented system. During the late 1970s (December, 1977 - October, 1978) a brief effort was made to create a focal agency for ocean management (Office of Ocean Management) but the experiment failed because of inadequate funding, a crippling workload, and poorly defined responsibilities (Bleicher, 1984). Somewhat more successful attempts have been made to adopt a coordinated federal approach to marine pollution (US Interagency Committee on Ocean Pollution Research, Development and Monitoring, 1981), but there are not similar integrated programs for managing the nation's deep water marine areas or marine resources.

One of the major controversies surrounding marine area management is the extent to which federally approved offshore activities are consistent with state Coastal Management Plans. Section 307 of the Coastal Zone Management Act allows states to require that federal activities, including permits and financial assistance, be consistent with their coastal policies. Coastal states and communities have sought to interpret this provision broadly by including offshore, as well as onshore, resource exploration, development and management activities within its scope. Thus, Fisheries Management Plans adopted by the National Marine Fisheries Service; as well as oil and gas lease sales, exploration, development and production activities subject to regulation by the US Geological Survey, Minerals Management Service and other bodies; have come under consistency review. Inasmuch as a negative review can be tantamount to a denial of permission for the affected activity, the consistency provision placed a powerful resource management tool in the hands of state and local decision makers and laid the basis for coastal zone management programs that more completely integrate onshore and offshore, planning and management of territory and resources.

Renewable Resources: There have been few inconsistencies between Fisheries Management Plans and Alaska's Coastal Management Program, and no significant disputes on the North Slope. Native populations have traditionally used renewable fish, mammal and bird resources for subsistence purposes, but related commercial ventures are rare because; (1) the Beaufort and Chukchi Seas are regions of relatively low biological productivity; (2) available species have previously been over-exploited; and (3) existing stocks are often protected by international, federal and state regulations (Salm and Clark, 1984). International Fisheries Commissions do not significantly manage fish stocks in northern Alaskan waters and most US National Marine Fisheries Service actions pertain to areas south of the Bering Strait. However, the International Agreement on Conservation of Polar Bears (1973), and the International Whaling Commission's restriction of bowhead whale catches to small annual quotas for North Slope artisanal fishermen, are important management actions. The latter have provoked strong opposition from the Inupiat, conservationists and pro-whaling nations (Leggett, 1985). Other species such as arctic seals and walrus are classified as endangered but lack effective means of protection (Salm and Clark, 1984).

Non-Renewable Resources: Offshore oil and gas developments have stimulated collection of information about arctic societies and environments at the same time as they threatened their stability. To date, three federal OCS oil and gas lease sales have been held in the Beaufort Sea (Figure 1). With each successive sale, tracts further from land have been offered for exploration. The most recent sale took place on 22 August 1984 when lands located up to 255 kilometres offshore in 200 metres of water, were included. In January 1984 the first commercially exploitable offshore oil discovery was made in the US sector of the Beaufort Sea (Seal Island) but results of test drilling elsewhere have proven to be disappointing (US Department of the Interior, 1985). Although there is, as yet, no commercial offshore production, submerged lands are available for exploration by special drill ships and other rigs sited on man-made gravel islands and concrete drilling structures designed to resist a variety of severe hazards. These include: persistent extremely low temperatures; superstructure icing; sea floors subject to pingo eruptions and other forms of instability; drifting ice blocks that gouge coastal sediments; massive lateral shearing forces imposed by accumulated pack ice and similar problems (US

Department of Commerce, National Oceanic and Atmospheric Administration, 1979).

Compared with other parts of the United States, relatively little was known about Alaskan environments and societies at the time of the first Prudhoe Bay discoveries. Recognizing this deficiency, the Minerals Management Service and the National Oceanic and Atmospheric Administration have mounted major Alaskan environmental studies programs. Voluminous reports on varied aspects of Alaskan ecosystems, pollutants, hazards and petroleum transportation are issued by the Offshore Continental Shelf Environmental Assessment Program (NOAA-OCSEAP). The Minerals Management Service supports a similarly large array of studies in the OCS Social and Environmental Studies Program (SESP). Additional research is published by the Leasing and Environment Office of MMS, Fish and Wildlife Service, General Accounting Office, State of Alaska, oil companies and industry associations, and other groups. For example, it is claimed that $53 million has been spent by the Minerals Management Service on 77 separate environmental studies in support of the most recent Beaufort Sea lease sale (Coastal Zone Management Newsletter, 2 August 1984). Much of this knowledge is conveyed to industry, government officials and the public via periodic workshops, information transfer conferences, meetings of the Alaskan Regional Technical Working Group of the OCS Advisory Board, and through widely distributed publications of the respective agencies.

Each offshore lease sale has drawn strong opposition from environmentalists, the state of Alaska, North Slope Borough residents, and the Inupiat community as a whole. Local residents are particularly concerned that noise and toxic spills associated with oilfield operations will interfere with the migration, survival and harvesting of bowhead whales and other species. Given the extent to which whale hunting for subsistence and the ritual sharing of whale meat is a central facet of Inupiat culture, this is an issue of paramount local concern.

North Slope disputes are but one facet of a larger national picture. Much of the US OCS oil and gas leasing program has been marked by state and local opposition. This often takes the form of legal suits about inconsistencies between offshore leasing and onshore Coastal Management Programs. Under Secretary James Watt, the Department of Interior strongly contested the authority of states and localities to bring these actions. His position was finally upheld by the US Supreme Court which determined that federal OCS sales are not subject to consistency provisions of the Coastal Zone Management Act (Secretary of the Interior *et al.* v. California *et al.*, No.82-1326, 11 January 1984). Hence, OCS exploration can legally be pursued independently of coastal management regulations. An important link between onshore and offshore components of coastal zone management has been formally severed. Voluntary federal consultation about consistency has continued under Secretaries Clark and Hodel. As an outcome of this process Secretary Clark agreed to reduce both the number and scope of future lease sales off the Alaskan coast, and to increase associated environmental safeguards. For example, 38 tracts were deleted from Lease Sale 87 to assure protection of bowhead whale migration routes and to preserve subsistence fishing. Similarly, the Inupiat village of Nuiqaut dropped its opposition to plans for linking an offshore oil field with the mainland. This was done when ARCO Alaska Inc. agreed to create two breaches in the structure so that marine life could pass along shore unimpeded.

Evaluation

Clearly there are advantages and disadvantages to the US system of separate Arctic marine and coastal management programs. The approach is bureaucratic, adversarial and litigious. Partisan domestic political and ideological motives sometimes intrude openly and directly on management decisions. This has already been evident in the offshore leasing program. It may become newly visible as Congress takes up proposals for expanding the Coastal Barrier Resources Act (1982) to include Alaska's North Slope. (The existing legislation exemplifies Reagan administration plans for reducing the scope of federal government by eliminating inducements to develop barrier islands.)

Yet, there are also strong positive aspects. US arctic coastal and marine programs are relatively comprehensive in scope, cognizant of the need for areally and ecologically integrated management, and significantly representative of affected interest groups. Although they lay great stress on the importance of scientific information for development purposes, the scale and variety of investigations is such that basic advances of arctic knowledge are also fostered.

The merits and deficiencies of US approaches can best be appreciated in comparison with Canada's coastal and marine management system.

Coastal and Marine Area Management in the Canadian Arctic

Canadian approaches bear some similarity to those of the United States, but the contrasts are more striking. Both countries share a desire to base management decisions on sound scientific knowledge about arctic environments and peoples. They also use Environmental Impact Assessment procedures to identify flawed development projects. However, constitutional frameworks that govern arctic areas, the status of aboriginal land claims, and the relative strengths of conservation and development interest groups, are quite different in the two nations. In addition, they integrate coastal and marine components of management programs to different degrees. The United States relies on formal administrative programs and supporting legislation to regulate offshore development and coastal management. Canada prefers to set coastal and marine issues within broader agency responsibilities, to base policy on loose advisory relationships among agencies, and to give Cabinet ministers paramount authority in decision making.

Regional Context

Canada possesses the world's longest arctic coastline and probably also its most varied arctic environment. Approximately 17, 000 Inuit live on or near the coast in scattered villages, together with an unknown number of oil and gas workers, miners, government officials and other metropolitan Canadians (Sugden, 1982). Like the North Slope of Alaska, the Canadian Arctic has experienced a vast increase in oil and gas exploration since 1968. Significant onshore and offshore discoveries have been made near the mouth of the Mackenzie River and the high islands of the Western Arctic. Methods for transporting these resources to southern markets have not yet been agreed upon. Proposals for overland pipelines have met with stiff opposition. Widespread concern about their negative impacts produced Canada's most celebrated environmental inquiry (Berger, 1977). Although applications for pipeline permits have been consistently refused, a new arctic pipeline proposal has recently been filed with the National Energy Board (Oil and Gas Journal, 9 July 1984).

The voyage of the US Tanker Manhattan (1969) intended to demonstrate the commercial feasibility of seaborne oil and gas transportation in the Arctic. Under the Arctic Pilot Project, Petro Canada and the Department of Transportation subsequently developed improved ship designs (Bradford, 1984). The Canadian government has approved a demonstration program for seaborne transshipment of oil from Panarctic's Bent Horn field in the Cameron Islands (77° N). On 22 August 1985 the first commercial oil shipment from the Canadian Arctic departed for a Montreal refinery via the ecologically sensitive Lancaster Sound passage. Critics have alleged that the vessel's hull did not meet federal standards for resistance to ice. At present, only one tanker cargo per year (100, 000 barrels) is scheduled, but this may increase to 300, 000 barrels in 1987, and to larger volumes thereafter.

The Manhattan's voyage had a more enduring impact on Canadian Arctic territorial claims. Shortly after it occurred an Arctic Waters Pollution Prevention Act (1970) was adopted. This empowered Canadian governments to enforce safety standards for ships using Arctic waters and to ensure that their owners are capable of making restitution for pollution damage. Some observers argue that Canadian sovereignty claims are weakened by the government's subsequent failure to take an active role in managing arctic marine resources. In defiance of the Act a US Icebreaker (Polar Sea) recently sailed through the Northwest Passage without seeking Canadian approval. Canadian resource development interest groups contend that seaborne transportation of oil strengthens national claims to arctic territory, whereas conservationists suggest that creation of arctic national parks and protected areas would provide a more effective mechanism for establishing sovereignty.

Relations between arctic conservation and development interest groups in the United States and Canada exhibit contrasts. From the beginning of arctic oil and gas development in Alaska, conservationists have exerted significant influence on development programs (e.g. demanding preparation of the Trans-Alaska Pipeline Environmental Impact Study; securing modification of offshore lease tract designations). In Canada, resource recovery objectives shaped initial public policies without much input from conservationists. However, following publication of the World Conservation Strategy (1980), Canadians have launched a series of ambitious northern conservation initiatives that may eventually prove to be more effective than US arctic conservation efforts.

Uncertainties about aboriginal ownership of land and resources hamper the growth of environmental management policies in the Canadian Arctic. Whereas the United States settled all land claims of Alaskan natives in 1971, a similar agreement has not been reached in Canada. Although claims in the western Arctic have now been settled after protracted discussions between the federal government and the Committee for Original People's Entitlement (COPE), there is less prospect of a resolution involving the Tungavik Federation of Nunavut (TFN) in the eastern Arctic. The coasts and offshore waters is open to question. Thus far, the Canadian government has argued against inclusion of offshore areas in settlement discussions.

Integrated Management: Opportunities and Limits

Under the Canadian Constitution, the federal government holds title to virtually all land north of 60° and to all offshore submerged land (Dwivedi, 1980). Unlike the United States, Arctic Canada does not experience conflicts between states (provinces) that manage coasts and federal agencies that oversee marine areas. In addition, many Canadian agencies have administrative responsibilities for both coastal and marine areas. Amongst others, these include the Canada Oil and Gas Lands Administration (COGLA); the Department of Indian and Northern Affairs; the Department of Fisheries and Oceans; and Environment Canada. In theory at least, this arrangement facilitates management of development activities that may affect interacting terrestrial and marine systems. For example, COGLA issues permits for oil exploration and drilling on Canada Lands (and waters), and it monitors agreements signed with commercial ventures. Other agencies have developed standardized hydrocarbon facilities siting procedures for use in arctic coastal regions (e.g. Environment Canada, Department of Indian and Northern Affairs) (Myers, 1984). Hence, the US pattern of federal inter-agency disputes between units with coastal responsibilities (e.g. OCRM) and units with marine responsibilities (e.g. MMS) is rarely repeated in the Canadian Arctic.

Nonetheless, there has been relatively little inter-agency or inter-sectoral coordination of coastal and marine area management among the various federal agencies (Harrison and Parkes, 1983). Efforts to stimulate inter-agency cooperation in support of improved coastal zone management have not prospered. In the late 1970s Canada seemed likely to follow the US precedent of creating a formal coastal management program. A National Coordinator of Environment Canada's Shore Zone Program was appointed and given responsibilities for encouraging inter-sectoral coastal planning (Pross, 1980). This post has since fallen vacant and been left unfilled. In the words of a recent commentator, "...today, emergence of any national office for coordinated programs of coastal zone planning and management is highly unlikely" (Hanson, 1983). A similar lack of enthusiasm for formally integrated coastal management has been recorded among provincial governments.

Prospects for the creation of an integrated marine policy are somewhat better. During 1984 this initiative was discussed within Environment Canada, but no formal proposals have been published or adopted (Environment Canada, 1984). However, a new initiative has emerged from recommendations made by the Task Force on Northern Conservation (Canadian Department of Indian Affairs and Northern Development; Yukon Territory: Northwest Territory).

Although the outlook for formally unified programs is mixed, several alternative mechanisms exist that encourage integrated approaches to marine and coastal management in the Arctic. These include: (1) large scale data gathering and research programs; and (2) federal environmental assessment procedures. The prospective development of standardized land use planning guidelines may eventually provide another stimulus toward unified coastal management.

Research: Collection of environmental data on the Arctic is a continuing activity of several federal departments. One of the more significant efforts is the Canada Lands Data System, pioneered by Environment Canada's Lands Directorate. This provides ecological surveys and land capability maps down to the 1:50, 000 scale for much of the arctic region. Unfortunately, this information is generally believed to be too coarse-grained for use in facilities siting studies (Myers, 1984).

There is a significant level of public consciousness about arctic environmental degradation, particularly due to oil spills. This has generated interest in associated scientific research programs and helped to influence the use of improved safety and conservation measures by industry. For example, controlled spill and burning experiments have been conducted in Labrador and the High Arctic to test hypotheses about the vulnerability of arctic ecosystems and the slow decay of petroleum in low temperature environments.

Recently, six federal agencies and the two territorial governments created a four year (1984-88) $22 million research program designed to address problems in the Beaufort Sea and the High Arctic Islands. This Northern Oil and Gas Action Program (NOGAP) is supported by general government revenues and now includes 85 projects. In content and scope, it resembles the US Minerals Management Service's Socioeconomic Studies Program and NOAA's OCSEAP program in Alaska. A second important research initiative involves the northern Environmental Studies Revolving Fund (ESRF). This is administered by the Department of Indian and Northern Affairs and financed - up to a maximum of $15 million - by direct levies on Canadian oil and gas companies. Proposals are solicited for work on waves, sea bottom sediments, oil spills, icebergs, social issues and other subjects relevant to oil and gas development projects. In addition, oil and gas firms are required to conduct scientific investigations necessary to secure regulatory approval. Widespread dissemination of environmental management decisions throughout the Canadian Arctic, but does not guarantee that improved management practices will be adopted.

Environmental Assessment: Public hearings on specific development applications often provide the initial impetus for environmental assessments (Dobbins *et al.*, 1983). The Berger Royal Commission on the Mackenzie Valley pipeline focussed national attention on a wide range of arctic onshore environmental issues (Berger, 1977). However, the federal Environmental Assessment and Review Process (EARP) is a major anticipatory mechanism for identifying environmental and social problems associated with arctic development (FEARO, 1979).

EARP was adopted in 1973 (Beanlands and Duinker, 1984). Unlike NEPA in the United States, it is an advisory procedure that is not necessarily invoked for all major federal environmental actions. Typically, one or more federal agencies identify a specific project that meets their criteria for review. Based on the results of Initial Environmental Evaluations carried out at the department level, a project may be referred to the Minister of Environment for additional review. This generally triggers the formation of an EARP panel, selected by the federal government and supplied with operational terms of reference specified by the Cabinet. The panel may be given broad or narrow guidelines as deemed appropriate.

Its conclusions and recommendations are submitted to the Minister of Environment for executive action. Several environmental assessments have been conducted in relation to proposed arctic oil and gas activities (Eastern Arctic Offshore Drilling Environmental Assessment Panel, 1978; Lancaster Sound Environmental Assessment Panel, 1979; Dome Petroleum Limited, 1982). Limited initial exploration has been completed in two of these areas and no future development has occurred. Development plans for the Beaufort Sea are still maturing. Although no major environmental or social disasters have occurred to date, it is difficult to assess the EARP's usefulness. A recent analysis of the EARP process's application to an offshore drilling proposal in South Davis Strait concluded that major improvements were necessary (King and Nelson, 1983). It has also been asserted that "With the exception of the Berger Inquiry, one must search hard to find any case where ecological considerations were a major component of a land use decision: not in the decision to build or even how to build the Dempster Highway, or the Alaska gas pipeline; or islands in the Beaufort Sea, or an others, despite millions of dollars spent on ecological research" (Theberge, 1981). Certainly, there is a slackening of enthusiasm for large scale environmental assessments in Canada, perhaps because of their cost and also because much collected arctic data still awaits interpretation.

Land Use Planning Guidelines: The status of efforts to develop a unified land use planning policy for the Canadian Arctic is unclear. A Northern Land Use Planning policy was proposed by the Minister for Indian Affairs and Northern Development in October 1982 (Runge, 1984). This initiative now appears to have lapsed or to be abeyance following changes in the federal administration. However, two Northern Conservation Policy Workshops (1983 and 1985) have produced land use plans that incorporate protected areas. At present it is likely that the Northwest Territories will adopt such a joint federal-territorial plan although less progress has been achieved in the Yukon. Whether either effort will produce a truly comprehensive land use program remains to be seen.

Marine and Coastal Management in Other Arctic Areas

No attempt has been made to analyze coastal and marine area management in Greenland, Norway, the Soviet Union or other arctic areas. It is known that Norway is beginning exploration for offshore oil and gas north of the Arctic Circle (Oil and Gas Journal, 17 December 1984), and that Russian exploration is already under way in the Barents Sea (Oil and Gas Journal, 11 February 1985). Although neither Norway or Greenland (Denmark) appear to have devoted significant attention to arctic coastal management, they and Russia are embroiled in several long-standing maritime boundary disputes (Archer and Scrivener, 1982-83). Nonetheless, there is a growing Soviet interest in the general subject of coastal management (Dergachev, 1981; Pokshishevskiy, 1982), and also increasing concern over the need to expand the existing skeletal network of Russian arctic nature reserves and national parks (Gerasimov, 1980).

Conclusions and Recommendations

One of the goals of this symposium is to further prospects for coordinated international management of arctic resources and territories. Based on the information presented here, it is clear that local, regional and national programs for managing arctic coastal and marine areas are uneven, often piecemeal, and fall well short of optimal performance. They too are in need of considerable modification. Therefore, the following conclusions are offered as pointers toward improved management at several levels of government.

First, the most promising basis for international cooperation lies in the fields of data gathering, research, environmental impact assessment and industrial site selection methodology. At least in North America, national and sub-national agencies or institutions that perform these functions already exist and often use similar procedures (e.g. OCS Environmental Studies Program/NOGAP; environmental assessment processes). The time is ripe for analyzing the research agendas, common impact assessment strategies, and standardized facilities siting methodologies. Might such be developed for use in all arctic coastal and marine areas, especially those that have yet to experience major industrial impacts?

With the exception of marine fish and mammals, it does not seem likely that many internationally shared coastal and marine management activities can yet be attempted in the Arctic. Individual nations first need to coordinate presently fragmented, sometimes counter-productive, ocean management plans and programs. With the exception of the United States, they also need to coordinate coastal management activities. Once this is accomplished, there is an urgent need to integrate separate coastal and marine management components into unified programs that reflect the ecological interdependencies of arctic lands and waters. To the extent that international conferences or other actions in support of these goals can exert pressure on national interest groups, they are warranted.

All affected interest groups should be involved in arctic coastal and marine management. As a minimum the following require representation in most forums: native peoples, non-native arctic residents, industrial developers, scientists, environmentalists, and local, regional, national and international governments. Unfortunately, arctic areas have often been viewed as dependent "peripheries" with respect to national public policies. Many protagonists find that it is difficult to secure a hearing for their viewpoints and decisions are sometimes formed by a narrow spectrum of opinion. Even scientists are not beyond reproach. A recent IUCN publication claims that, because no significant "public" exists in polar regions, scientists and environmentalists should speak on behalf of larger, non-resident interests (Salm and Clark, 1984). Yet, other analysts contend that scientists are themselves culturally constrained and experience great difficulty appreciating native peoples' concerns that may also be valid bases for public policies (Bielawski, 1984; Sugden, 1982).

The representation of affected interests and the resolution of interest group disputes are best undertaken at local and regional (i.e. state, territory, province) levels of government. Alaska's North Slope Borough Coastal Management Program is one example of a mechanism that gives under-represented groups like the Inupiat, direct access to public policy forums. In time, it will be possible to evaluate the success of this program, and to explore possibilities for creating appropriate alternatives that can achieve equitable - as well as effective - management of arctic coastal and marine areas. To achieve this goal it will be necessary to analyze the record of policy and management disputes in all arctic areas, with a view to identifying workable, environmentally-responsible arrangements that incorporate a broad spectrum of inputs from arctic interest groups.

Notes

* For the purpose of this paper the Arctic is defined as all territory north of the Arctic Circle.

** In their own parlance American Eskimos are referred to as Inupiat and Canadian Eskimos as Inuit.

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International Approaches to Arctic Heritage Use and Conservation

Bernd von Droste

Arctic international cooperation began more than one hundred years ago when in 1882/83 the first International Polar Year resulted in a network of circumpolar stations run by eleven nations to make simultaneous observations over a period of thirteen months in a wide range of disciplines, including biology (Dooge and Baker, 1984).

At that time scientific interest in exploration of an unknown part of our globe prevailed. Since then the world as a whole and the Arctic in particular have changed profoundly. Today the Arctic region is entering a period of greatly accelerated economic, social, strategic and political change. The driving force behind the changes taking place is resource development activities. Although the present scale of these activities is not inconsequential, it is small in comparison to their projected growth for the years to come.

The increasing scale and intensity of human activities are unprecedented in history and threaten the future of the unique natural and cultural heritage of the Arctic. Major preoccupations are, for example, effects of possible climatic changes, acid rain, the survival of already marginalized human cultures and the risks of major oil spills in Arctic waters. Only today, through major national and international scientific efforts, are we beginning to understand the unique fragile nature of the natural and social systems of the Arctic, of its natural and cultural heritage, and the key role of the Arctic in worldwide life-supporting processes.

Unesco is actively involved in both the international scientific cooperation in the north and arctic heritage preservation. These are rather distinct but closely linked activities. Scientific efforts have helped to recognize and estimate the worth of the Arctic heritage as well as to identify rational ways and means for its lasting preservation.

Since 1971 the Man and the Biosphere Programme (MAB) of Unesco has been concerned with building up the scientific knowledge needed for maintaining the natural resources of the biosphere. The MAB Programme deals with the whole range of terrestrial, water and coastal ecosystems from equatorial to polar zones, from littoral to high mountain systems.

However, it was not until 1981, that the launching of the Northern Science Network by MAB Canada gave a boost to cooperative MAB research in the north through its focus on the issues of human use of natural renewable resources and the problems that modern economic development is imposing upon indigenous northern cultures.

Roots (1985) summarized the rationale for launching a special MAB Northern Science Network by stating:

> The northern high latitude regions are characterized by distinctive physical and biological features and processes but also by distinctive social, cultural, economic and technological features that have many relationships to the natural environment. These distinctive characteristics and relationships, environmental, social and institutional are to a large degree shared by all northern countries.

Therefore, information and research required to address these problems tend to be circumpolar rather than national in scope. Notwithstanding close north-south links, there is more in common between the scientific, social and economic aspects of northern regions of different countries than between the northern and southern parts of the same country.

An important task of the MAB Northern Science Network is to provide liaison and information exchange between MAB and other interdisciplinary activities that can contribute to understanding the interaction between the northern environment, its resources, and human needs and activities.

Examples of international scientific activities concerned with the north with which the MAB Northern Science Network cooperates include:

- the Northern Water Basin Research Programme associated with the International Hydrological Programme;
- the Arctic area sampling network which covers information on air quality from the circumpolar area;
- the polar sub-program of the World Climate Research program of WMO; and
- activities under the International Polar Bear Programme, and
- the high latitude component of the world conservation strategy of UNEP, IUCN and WWF.

Taking these, and other related activities into account, three foci were initally selected for the Northern Science Network.

- Studies on the ecology and land use of subarctic birch forests;

- Development, research and monitoring program in biosphere reserves and other protected areas in northern regions;

- Socio-economic and environmental effects of land-use practices and grazing animals in the north.

Already ten countries are associated with these research efforts. A permanent Secretariat headed by Dr. Milton Freeman has been established at Edmonton, through the generosity of the University of Alberta in Edmonton.

One of the most complex themes which the Northern Science Network coordinates covers land use practices and grazing animals.

A problem common to all northern countries is the inherent conflict between the needs of large grazing animals, whether herded (reindeer, sheep) or wild (caribou, musk ox) and the activities of other users, particularly industrial (logging, mining, petroleum) or recreational and tourist (winter sports, hunting and attendant infrastructure). The conflict is for the most part indirect, rather than direct competition for habitat; the animals need to keep moving without undue constraint in order to gather biological energy over a large area, and any activities that interfere with the movement or cause alarm (thereby forcing the animals to use up precious energy), can have serious and lasting effects on herd productivity. The resulting socio-economic repercussions, and conflicts between policies, make this theme particularly appropriate for MAB study.

In addition there will be unique possibility for future comparative studies with grazing systems on arid and semi-arid lands currently studied under IPAL, MAB's integrated project on arid lands.

One other major objective of the Northern Science Network is the establishment of a circumpolar biosphere reserve network which, in association with other categories of protected areas, would help to preserve representative ecological areas. Multiple purposes such as *in situ* conservation of genetic resources, preservation of traditional human cultures, environmental research and ecological monitoring could be combined.

A circumpolar biosphere reserve network is now taking shape. In fact it already covers vast stretches of land, coastal and marine area, but admittedly, its potential for ecological research and monitoring is as y et not realized. So far, this emerging network includes, among other areas, seven rather vast areas which reflect the diversity of Arctic natural heritage: Northeast Greenland National Park (70 million hectares), by far the world's largest protected area; Northeast Svalbard National Reserve (1.5 million hectares); Noatak Biosphere Reserve in Alaska (3 million hectares); Aleutian Islands Biosphere Reserve (1.1 million hectares); Denali Biosphere Reserve in Alaska (780,000 hectares) and Laplandsky Zapovednik (278,000 hectares), located in the USSR.

Although this is already an impressive list, major gaps still exist. These gaps are particularly apparent whenever we consider the vast marine areas of the Arctic such as the Bering and Chukchi Seas. Ray (1979) has drawn attention to these areas which are immensely productive and rich in terms of renewable and non-renewable resources.

For example, the Beringean region is at times temperate and at other times arctic. Because of the seasonal ice cover the total natural production of the Bering Sea is considerably enhanced. Two other major sources, rivers and lagoons, contribute to total production. The annual discharge into the Bering Sea from rivers of the USSR is about 100 km^3 of water. Alaskan rivers, particularly the Yukon and Kuskokwin, contribute about 300 km^3 per annum. Rivers bring in sediment, nutrients, and, in certain cases pollutants, the latter so far apparently in small amounts. Lagoons are the other major source. It is obvious from this that river and lagoon habitats are prime sites for the creation of biosphere reserves. A good part of the nutrition of the region depends on them. Ice is also implicated in the ecology of marine mammals and birds which are also dominant in Beringea. Far from impeding the distribution of marine mammals, sea ice aids some of them. There are 25 marine species found in Beringea. Birds and fishes are also extremely numerous in this region.

The major threat to the future survival of the highly complex and productive coastal marine ecosystem of Beringea is hydro-carbon (oil) spills under sea ice.

Beringea has been mentioned as an example of a large and highly productive marine arctic area, where conflicts are shaping up between heritage preservation and economic exploitation. It is also an area where international cooperation is mandatory for achieving success since this sea is a resource shared by several circumpolar nations and should be considered as one of the great commons.

Development of a circumpolar biosphere reserve network in the Arctic is clearly relevant to environmental conservation and resources management in northern countries. But their value and significance extends far beyond the north itself. To take monitoring in biosphere reserves as an example: "polar regions clearly constitute a special focus for monitoring of atmospheric CO_2 and climate" (Washburn, 1980). Thus, it can be expected that the northern biosphere reserve network will become increasingly important as a place for permanent baseline studies within an emerging worldwide network for monitoring changes in the environment and in world climatic, as intitated under UNEP/GEMS and WMO.

The Northern Science Network program can also be seen as a logical counterpart to MAB studies in the humid and arid tropics. It is one end of the spectrum of MAB activities ranging from areas of high biological activity to those of low energy. Without studies in high latitudes MAB could not truly fulfill its mandate , a program on Man and Biosphere.

Let us turn now to the Convention concerning the Protection of the World Cultural and Natural Heritage (the "World Heritage Convention") which was adopted at the Unesco General Conference on 16 November 1972 and came into force on 17 December 1975. Its origins can be traced to two separate, but related, factors. The first is that by 1972 the international community was becoming increasingly receptive to the concept of "common heritage." In the context of the Convention, this concept maintains that there are certain outstanding natural and man-made features such as the Serengeti or the Pyramids, the Galapagos Islands or the Taj Mahal, which are more than the heritage of just one State. They constitute part of the heritage of all people, and mankind as a whole has certain rights with respect to their conservation. The second factor is that by 1972 the international community had shown itself willing to take positive action to help protect these sites. When the Nubian monuments of the Upper Nile, including the nine-metre high statue of Ramses II at Abu Simbel, were threatened by flooding in 1960 as a result of the newly-constructed Aswan High Dam, the response of the international community was prompt, and international campaigns were organized by Unesco and others to save the famous monuments from destruction. On the natural side, the International Union for Conservation of Nature and Natural Resources (IUCN) was active in the 1950s and 1960s in securing protection for important natural habitats, aided by the financial support of a variety of governments, companies and individuals. As the threats grew, however, it became increasingly evident that a permanent legal, administrative and financial framework for the identification and conservation of areas of outstanding cultural and natural importance would greatly assist the ad hoc efforts of Unesco, IUCN and others.

The World Heritage Convention provides such a framework. Its objective is the protection of natural and cultural areas of "outstanding universal value," and it established a World Heritage Committee, a World Heritage List, a List of World Heritage in Danger and a World Heritage Fund to help it achieve its goal. The World Heritage Committee is responsible for selecting cultural and natural sites of outstanding universal value and for including them in the World Heritage List or, if they are seriously threatened, in the List of World Heritage in Danger. The Committee is also responsible for using the money in the World Heritage Fund to help protect sites which have been or may be included in either of the World Heritage Lists. The Committee uses IUCN as an advisory body for the evaluation of natural sites and ICOMOS (International Council for the Conservation of Monuments and Sites) for the evaluation of cultural properties.

Although it has only been fully operational for a few years, there are already signs that the Convention will prove to be an extremely useful legal conservation instrument. Almost fifty areas of outstanding natural, as opposed to cultural, value have been included in the World Heritage List, and the Convention has already helped protect several of them. The role played by the Convention in halting construction of a dam on the Gordon-below-Franklin River, which would have flooded a large area of temperate rainforest in South West Tasmania, is probably the best known example.

It was recognized early that the World Heritage Convention also needs to be implemented in the northern regions which are rich in terms of both natural and cultural heritage. One outstanding example for international cooperation is the joint nomination and establishment of Kluane National Park located in Canada and Wrangell-St. Elias National Park located in Alaska, US, as a World Heritage property. This has created the world's largest heritage site, covering about 6 million hectares with superb features which alone justify its inclusion in the World Heritage List.

The dominant natural characteristic of the joint properties is the ice and snowfields of the St. Elias Mountains. This is the largest non-polar icefield in the world and contains examples of some of the world's most spectacular glaciers. The recession and advances of the glaciers are the dominant natural force of the region. In particular, the area is noted for its concentration of presently surging glaciers. A recent example is the Steel Glacier, which surged over 8 kilometres during the period of 1966-68.

The movement of glaciers in this World Heritage Site provides some of the best global examples of glaciation and the modification of landscape by glaciers. The geomorphic agents associated with glacial and peri-glacial environments; ice, frost, melt waters and wind, have been at work producing a wide range of interesting landforms, including significant examples of sand dune formations and loess steppes.

There is a rich variety of land ecosystems in the site. Within the montane forest, coastal forest, subalpine zone, and alpine tundra, are complex and intricate mosaics of plant life, at various successional stages. All forms of herbivorous animals common to Alaska and northwestern Canada are represented in the fauna of the joint properties, some in numbers exceeded nowhere else. Over 14,000 Dall's sheep, the single largest group in the world, are found on lands encompassed by the site. Some 600 grizzly bears, which is one of the largest protected populations in the world, range through the area.

The immense site contains the entire watershed of dozens of major rivers and pristine ecosystems that are unaltered by human activities and isolated by natural barriers from external influences. There are few places in the world where the ecological processes such as predation, migration, mortality and natality are governed only by natural stresses and the evolutionary changes in the ecosystems.

As another example let me briefly tell the fascinating story of the first historic site to be placed on the World's Heritage List symbolizing the common origin and close ties of the circumpolar world.

One summer day nearly 1000 years ago – however, much later than the Inuit migration over the various parts of the circumpolar world–a long, high-prowed open boat from Greenland cast anchor at an island somewhere off the coast of North America. The single square sail was furled and the crew of thirty-six men went ashore. There was dew on the grass, and when they raised some to their lips "it seemed to them that they had never tasted anything so sweet." Later, they sailed on to the nearby mainland, where their vessel was left high and dry on shallows as the tide went out, so that "the sea seemed far away." Here, after getting off the flats and anchoring, they built some shacks and spent the winter, fishing, hunting and exploring. This is an excerpt from the Groenlandinga Saga describing Leif Ericsson's historic first contact with the continent which was to become North America.

It was nearly nine centuries later, in 1960 that a Norwegian explorer and writer, Helge Ingstad, came upon the site. He was making an intensive search for Norse landing places along the coast from New England northward, and at L'Anse-aux-Meadows, beside Epaves Bay, he discovered all that was left of that old colony, a group of grass-grown mounds which looked as if they might be house remains. The location fitted well with the Saga accounts, and so for the next eight years Helge and his wife, the archaeologist Anne Stine Ingstad, led a group of archaeologists from Canada, the United States, Scandinavia and Iceland in excavations to explore the site. What their digs turned up was plentiful evidence of the first known European community in the Western Hemisphere.

L'Anse-aux-Meadows thus represents many firsts for the New World; the first European settlement; the first evidence of iron working; the first encounter between Europeans and native Americans. It is no wonder, therefore, that is was among the first twelve sites to be included on the World Heritage List in 1978.

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International Agreements for Conservation: Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

Eugene Lapointe

Introduction

Ten years ago last month, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, commonly known as CITES or the Washington Convention, came into force. It was one of several nature conservation treaties to be signed in the 1970s, but it is the only one to attempt to control trade in wildlife on an international level. Trade in wildlife products goes back for many centuries, but in the 1960s and early 1970s there was a dramatic increase in the levels of trade and, most worryingly, in levels of poaching, particularly in Africa, Asia and South America.

CITES was negotiated with two major objectives in mind. The first was to stop poaching and illegal trade. Illegal trade benefits only the few smugglers involved and can lead to serious depletion of wildlife populations. CITES was signed in the recognition that the efforts of the developing world to control poaching and illegal trade required the cooperation of the developed world which was providing the markets for the illegally obtained products. The second major objective of CITES was to encourage legal trade in those species able to withstand some exploitation, but at the same time control the trade to ensure it is carried out on a rational, sustainable basis.

Canada demonstrated its faith in the CITES concept by being one of the original signatories to the Convention. However, there was some scepticism among other governments as to whether the permit system established by CITES to implement its objectives would actually work and also a fear that the Convention might be manipulated into a tool for preventing trade in wildlife. The scepticism has proven unfound. CITES is by no means perfect and illegal trade is still a serious problem. But CITES has demonstrated that its permit system can work and that it does not prohibit or discourage legal trade in species able to sustain some exploitation. Certainly, there is a category of species under CITES - those listed in Appendix I of the Convention - in which international commercial trade is prohibited. But Appendix I includes species threatened with extinction, and protection for such species to allow time for their recovery is entirely consistent with sound management practices. For the vast majority of species, the only restriction on the trade is that it should be under government supervision and shall not be so high as to cause populations to become depleted. Indeed CITES actually encourages legal traders by making life more difficult for the poacher and smuggler. The CITES system is entirely consistent with the principles of the World Conservation Strategy, now generally accepted as the blueprint of modern conservation philosophy.

The extraordinary growth of CITES from ten parties to 1975 to eighty-nine today is ample testament of the widespread acceptance of the principles of CITES and of its practical value. We now have a larger membership than any other international conservation agreement. This World Heritage Concentration runs us a close second but we are still managing to keep our noses in front.

After those introductory remarks, it is appropriate to describe in rather more detail how CITES works and to pick out some points of particular relevance to conservation in the Arctic.

Rules Governing Trade in CITES Species

There are three appendices to CITES, and the Convention regulates international trade in specimens of those species that are listed in the Appendices. These include both animals and plants. Except in a few circumstances, such as when a specimen is a personal effect or was acquired before the Convention came into force, international trade in these species is prohibited without a CITES permit. Each party is required to establish a Management Authority and a Scientific Authority to operate the permit system. The Management Authority is concerned with the mechanics of trade, such as checking whether a specimen was legally obtained and granting permits. The Scientific Authority is concerned with biological aspects and must be satisfied that the issuance of a permit will not have a harmful effect on the species concerned. The Secretariat is available on an international level to help with any problems that arise in implementation of the permit system.

Appendix I Species

Appendix I is reserved for animals and plants threatened with extinction and contains about 800 species. International trade in Appendix I species is strictly controlled, and as a general rule imports of Appendix I species for commercial purposes are not allowed. However, this does not stop all international trade. Permits are frequently given for trade in Appendix I species for educational or scientific purposes and for hunting trophies. I would like to emphasize the point about hunting trophies. Trophy hunting by wealthy foreign nationals under carefully controlled conditions can be an important source of revenue both for the country where the hunting takes place and for the conservation of the species being hunted. However, hunters would clearly be unwilling to pay the large licence fees if they could not take their trophies home. Listing a species in Appendix I will not stop a hunter from shooting a specimen of that species and taking the trophy home provided the country where the trophy is taken issues an export permit and provided his own country is satisfied that he is importing the trophy for personal use and not for commercial gain.

The strict protection for commercial trade given by CITES to Appendix I species has proved highly beneficial in most cases. Indian populations of the Tiger, an Appendix I species, have doubled in the last decade, and populations of another Appendix I species, the Nile Crocodile, are now sufficiently stable in much of Africa that the Parties to CITES recently agreed to transfer some Nile Crocodile populations to Appendix II. These are important achievements, and CITES can justifiably claim much of the credit. However, to be fair it should be noted that the picture is not completely rosy. In spite of its Appendix I status, populations of Black Rhinoceros have continued to decline drastically because of poaching and illegal exports of rhino horn to North Yemen and elsewhere. This is a very serious problem to which we must give our urgent attention.

Appendix II Species

Compared to the relatively few species in Appendix I, Appendix II is enormous, containing over 40,000 species. Also in contrast to Appendix I species, Appendix II species may be commercially traded provided that the country of export has granted an export permit. CITES imposes no specific limits on numbers of Appendix II species that may be traded but imposes a duty on exporting countries only to grant an export permit if they are satisfied that the export will not be detrimental to the survival of the species.

Although CITES is designed to prevent over-exploitation of Appendix II species, it is important to emphasize that there is plenty of scope for a sizeable trade in these species within the parameters set by the Convention. Hundreds of thousands of specimens of Appendix II species are traded quite legally and quite properly each year. CITES does not hinder this trade, it merely seeks to ensure that it is sustainable.

Appendix III Species

Appendix III is much less used than Appendices I and II and is quite different in concept. Appendix III provides a mechanism whereby any Party which regulates the exploitation of a species not included in Appendix I or II can seek international help in enforcing that regulation.

To give an example of how this works, Canada has listed the Walrus in Appendix III (it is not in Appendix I or II) in order to inform Management Authorities in other countries that trade in Walrus products is regulated in Canada and that imports of those products from Canada are illegal without a CITES export permit issued by the Canadian Management Authority. In spite of its potential value as an international aid to enforcement of national legislation, only 10 Parties have so far listed a total of some 150 species in Appendix III. These are disappointingly low figures, and the Secretariat is trying to encourage Parties to make more use of Appendix III. In situations where a country controls trade in a relatively common species, it is infinitely preferable for that country to add it to Appendix III rather than try to add it to the already overloaded list of species in Appendix II which should be limited to species that are genuinely under some degree of threat or potential threat.

Changes to the Appendices

Each party to CITES has the right to propose an amendment to Appendix I or II. There is a procedure which enables proposed amendments to be considered by postal vote, but they are normally considered at meetings of the Conference of the Parties which take place every two years.

So far there have been five of these biennial meetings, and happily the sixth meeting will take place in Canada in 1987. There are always numerous proposals to amend the appendices at each meeting of the Conference of the Parties, and many of them are often controversial. Let us briefly consider three proposals made at recent meetings, two of which affect arctic species, to illustrate the controversies that can arise but also because each of the three raises issues which have wider implications.

The first concerns the Narwhal. The Federal Republic of Germany submitted a proposal to the most recent meeting of the Conference of the Parties in Argentina a few months ago to transfer the Narwhal, an Appendix II species, to Appendix I. Considerable doubt was expressed at the Conference as to whether the Narwhal is actually threatened with extinction, an important criterion for Appendix I status. However, previous Conferences have included other cetaceans in Appendix I when the biological justification for listing was rather dubious. So the "special case" treatment that whales have received in the past meant that the defeat of the German proposal was by no means certain right until the vote was taken. The proposal was finally defeated, but only after a member of the Inuit Community of Canada made a simple point which it is very important to emphasize - that CITES only covers international trade. CITES does not affect subsistence use and it does not affect internal trade. The Inuit explained that Inuits are the only users of Narwhal and that if the species was put in Appendix I it would not stop them killing Narwhal for food and other subsistence uses. However, rather than killing males, which the Inuits do now because they can work the tusk and export it, they would kill females because their meat is better. The net result would be worse for conservation. The argument received considerable sympathy at the Conference and was a significant factor in the defeat of the German proposal.

The second proposal which raises some important questions concerns the Gyrfalcon. When CITES first came into force, the Gyrfalcon was listed in Appendix I. However, following research by US and Canadian biologists which indicated that North American populations of Gyrfalcon were not threatened with extinction and could sustain some exploitation, the North American population was transferred to Appendix II in 1981. This decision demonstrated both the flexibility of CITES and its appreciation of regional concerns. Numerous species are rare in some parts of their range but are commoner in others, and the mechanism of "split listings" under CITES - whereby one population of a species is in Appendix I and another is in Appendix II - is an extremely useful way of allowing exploitation in those areas which can withstand it while maintaining strict protection elsewhere. There are some thirty split listings in all.

However, while CITES does all it can cater for regional concerns, regions should also remember that CITES is a worldwide convention dealing with global problems. Sometimes regions need to sacrifice their local interests for the greater good. One of the dangers of "split listings" is that the resumption of legal trade in the commoner populations of the species can lead to an increase in illegal trade in the rarer populations. This is what happened in the case of the Gyrfalcon. The resumption of the legal trade in these valuable birds - they are highly prized by falconers and are reputed to fetch up to $100,000 a pair in the Arab world - led to an increase in illegal trade in the rare and endangered European populations of the species. In order to combat this illegal trade, Norway and Denmark proposed transferring North American populations of Gyrfalcon back to Appendix I at the fifth meeting of the Conference of the Parties in Buenos Aires earlier this year. Canada and the United States understandably opposed the proposal because of the healthy state of North American Gyrfalcon populations, but the Conference decided that the need to protect European populations was even greater and approved the Norwegian and Danish proposals.

The final proposal to amend the Appendices which will be considered here concerns the Nile Crocodile. Like most Appendix I species, the Nile Crocodile was included in Appendix I when CITES was first signed and without much consideration of the scientific merits of demerits of its Appendix I status. A few years later, the Conference of the Parties decided upon criteria which should be satisfied before any species could be deleted from Appendix I or II or transferred from Appendix I to II. Among other things, these criteria suggested that there should be a well documented population survey and an indication of the trend of the species in order to ascertain whether or not it could withstand a decrease in protection. A number of Parties have since become dissatisfied with this criterion, particularly in relation to those species such as Nile Crocodile which they felt should never have been put in Appendix I in the first place, but about which they had insufficient population data to satisfy the criterion. To resolve this situation, the Buenos Aires Conference agreed to make it possible to transfer a species, or a population of a species, from Appendix I to II even when detailed population data are not available provided it can be generally accepted that the species is sufficiently abundant to withstand some exploitation and subject to the establishment of quotas for the species by the Conference of the Parties. The Buenos Aires Conference then agreed to transfer certain populations of Nile Crocodile from Appendix I to II and set quotas on a country-by-country basis. The Conference also established a quota system for ivory, and I suspect that we may see more quota systems being established for other species in future.

System of Administration

Perhaps the most remarkable thing about CITES is its system of administration. No other Convention has such a huge network of Management Authorities and Scientific Authorities operating on a national level throughout the world. And I like to think that no other conservation Convention has a better Secretariat than we have to oversee things on an international level. The functions of the Secretariat are really very important. We arrange and service meetings of the Conference of the Parties. We hold seminars to help train Management Authorities, and Secretariat staff have undertaken missions to over a dozen countries to help solve enforcement problems which have arisen. We have organized the production of security paper and security stamps for use on CITES permits to help stop forgeries, and we recently established an ivory unit with a view to clamp down even more tightly on illegal trade in ivory.

But perhaps the most important function of the Secretariat is to act as a clearing house. If, for instance, a Party takes stricter domestic measures than are required by CITES and notifies the Secretariat, we will notify all other Parties. Two examples of this in recent years are the decisions taken by Zaire to ban the commercial export of ivory and by Brazil to ban the export of all wildlife. Notification by the Secretariat of these kinds of measures are extremely valuable to other Management Authorities because they are then alerted to the fact that certain transactions, such as imports of ivory from Zaire or of any wildlife product from Brazil, will almost certainly be illegal.

The Secretariat also receives the annual reports which each Party is required to submit on its trade in CITES species. The Secretariat has arranged for the Wildlife Trade Monitoring Unit in England to computerize these trade statistics so that a detailed analysis of international trade can be produced on a species by species level. Annual reports are a valuable means of helping uncover instances of illegal trade. For example, an analysis of annual reports led the Secretariat to notice a marked increase in wildlife exports from Paraguay in 1978, and further investigation revealed that large quantities of wildlife were being smuggled into Paraguay from neighbouring countries and then exported to Europe with forged permits. Reports have not been as useful as they might have been because many have been late or inadequately presented, and some Parties have never submitted a report at all. Following a great effort by the Secretariat to increase the quality and rate of submission of annual reports, the situation has improved but is by no means perfect yet. It is good to note Canada's reporting record is considerably better than most Parties!

Limitations of CITES

It has already been mentioned that CITES is limited to international trade, and it is important to emphasize that CITES is only one piece, albeit an important one, in the jigsaw of natural resource utilization and conservation. CITES cannot do everything itself, it has to be reinforced by other international agreements. For example, Canada is not a member of the International Whaling Commission so its only international commitment to whale conservation is through CITES. CITES covers international trade in whale products from Canada, but this is only half the picture. CITES has no jurisdiction over whales taken within Canadian waters and utilized within Canada.

The limitations of CITES are also apparent with respect to seals and sealing. The numbers of North Pacific Fur Seas taken each year are controlled by the North Pacific Fur Seal Commission, and the size of Harp and Hooded Seal harvests are subject to various international agreements involving Canada, Norway and the USSR as well as the Northwest Atlantic Fisheries Organization. CITES only deals with the international trade aspect. Indeed a major factor in the defeat of various proposals that have been made in the past to add Harp and Hooded Seals to Appendix II of CITES has been the argument that seal conservation is taken care of in another fora and the CITES listing will not add anything of any great significance.

Conclusion

Whether you are impressed by the successes of CITES or are struck by its failures - and hopefully you will agree that its advantages outweigh its deficiencies - there is no question that CITES is here to stay. With a membership of 88 and increasing, there is now little point in any wildlife trading nation staying outside the Convention because there are ever fewer countries with which it can freely trade. Furthermore, as CITES matures and becomes more effective in pursuing its goals of rational use of wildlife and eradication of illegal trade, the advantages of participating in the CITES system will become even greater. Surely this will be of benefit to people and wildlife in the Arctic and throughout the world.

The Ramsar Convention and Arctic Conservation

Daniel Navid

Introduction

There is one global nature conservation convention dedicated to the preservation of particular ecosystem types along with species dependent upon them. This is the Convention on Wetlands of International Importance especially as Waterfowl Habitat, also known as the Ramsar Convention, from its place of adoption in 1971 in Iran.

The Ramsar Convention is receiving increasing attention throughout the world as the importance of wetland areas for conservation and development concerns is becoming more and more appreciated. Indeed, the value of wetlands for the conservation and management of numerous species, for economic benefits from fisheries, agriculture, water storage and flood control, as well as from tourism and recreation and for moral or aesthetic reasons is well documented (Noble and Wolff,1984). Unfortunately, so too is the sorry situation that wetlands are among the world's most threatened habitat, due to accelerating drainage, reclamation, pollution and other factors (Nowicki and Nowicki-Caupin, 1984).

Perhaps less well appreciated is the fact that cooperation among countries is a prerequisite for effective wetland management measures, given the international linkages peculiar to these habitats.

Wetlands, being dependent upon their water supply, are affected, for example, by impacts upon streams and rivers occurring at considerable distances and in many cases beyond national boundaries. Wetlands are seriously degraded by transboundary air and water pollution, and much of the wetland fauna are migratory species whose conservation and management require international cooperation.

Hence, it is particularly appropriate that there exists an international agreement which focusses upon wetland conservation. Through the provisions of the Ramsar Convention, States have opportunities to consult to adopt agreed upon management measures and to indicate to the world at large that special attention will be devoted to conserving selected wetland sites of International Importance. International cooperation and consensus building are the key foci of the Convention. This approach, rather than confrontation or the apparent coercion prevalent in some other international fora has been responsible for considerable conservation benefits and would seem to be especially appropriate for the pursuance of conservation measures in the Arctic region.

This paper will provide an overview of the Ramsar Convention, describe future initiatives being planned under it and underline its particular relevance for Arctic States.

General Background on the Convention

The Wetlands Convention was adopted following a series of international conferences and technical meetings mainly held under the auspices of the International Waterfowl Research Bureau (IWRB). It entered into force in late 1975 upon the deposit of an instrument of ratification by Greece, the seventh State to do so. As of 1 July 1985, the Convention has 39 Contracting Parties throughout the world - Algeria, Australia, Austria, Belgium, Bulgaria, Canada, Chile, Denmark, Finland, German Democratic Republic, Federal Republic of Germany, Greece, Hungary, Iceland, India, Iran, Ireland, Italy, Japan, Jordan, Mauritania, Morocco, Netherlands, New Zealand, Norway, Pakistan, Poland, Portugal, Senegal, South Africa, Spain, Suriname, Sweden, Switzerland, Tunisia, Union of Soviet Socialist Republics, United Kingdom of Great Britain and Northern Ireland, Uruguay, Yugoslavia. In addition, France and Egypt have accepted the 1982 Convention Protocol and will become Contracting Parties to the Convention automatically upon the entry into force of the Protocol. All Arctic States are Parties to the Convention, with the exception of the United States where ratification procedures are currently underway.

The Secretariat, or Bureau as it is referred to in Article 8 of the Convention, is provided by my organization, the International Union for Conservation of Nature and Natural Resources (IUCN). We are assisted in this task by the IWRB as Scientific Advisor. Depositary services are provided by Unesco.

The broad objectives of the Convention are to stem the loss of wetlands and to ensure their conservation in view of their importance for ecological processes as well as their rich fauna and flora. To meet these objectives, the Convention provides for general obligations relating to the conservation of wetlands throughout the territory of the Contracting Parties and for special obligations pertaining to those wetlands which have been designated in a List of Wetlands of International Importance.

Specific Provisions of the Convention

Scope

The Convention takes an extremely broad approach in defining wetlands. These, as defined in Article 1, are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine waters the depth of which at low tide does not exceed six metres. In addition, Article 2 provides that wetlands covered may incorporate riparian and coastal zones adjacent to the wetlands and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands.

As a result of these provisions, the coverage of the Convention extends to a wide variety of habitat types including rivers, coastal areas, tundra and other environments found in the Arctic.

Main Obligations

There is a general obligation, as noted above, for the Contracting Parties to include wetland conservation considerations within their national planning. Article 3, para. 1 provides: The Contracting Parties shall formulate and implement their planning so as to promote....as far as possible the wise use of wetlands in their territory. The Contracting Parties have interpreted this wise use requirement to mean the maintenance of the ecological character of wetlands (Recommendation 1.5 of the First Conference of the Contracting Parties, Cagliari, 1980), which has significant implications for wetland conservation measures.

A second obligation under the Convention is the designation of wetlands for inclusion in the List of Wetlands of International Importance maintained by IUCN as the Convention Bureau. Specific conservation duties pertain to the listed sites. At least one site must be designated by each Contracting Party (Article 2, para.4) with selection based on international significance in terms of ecology, botany, zoology, limnology or hydrology (Article 2, para.2). Criteria for selection, with greatest relevance to importance for waterfowl, were adopted by the Contracting Parties at their 1980 Conference (Cagliari criteria).

The List of Wetlands of International Importance

In practice, the Contracting Parties have gone far beyond the mandatory designation of only one site, as of 1 July 1985 some 300 sites covering in excess of 20,000,000 hectares have been designated for the List. Furthermore, no site has been deleted from the List and replaced by another, despite the possibility that this might be done, by a Contracting Party in its urgent national interest (Article 4, para. 2).

An analysis of the ecological coverage of Ramsar sites has been made for both the First and Second Conferences of the Contracting Parties (IUCN/IWRB, 1980, 1984). It has been noted that although most Contracting Parties had designated wetland sites on the basis of their importance for waterfowl, other faunal and floral interests had obviously been taken into consideration. To illustrate this point, examples can be given of designating sites in Italy and the United Kingdom of relatively minor importance for waterfowl but included on the basis of their botanical/limnological interest. This broadening trend has continued and presently a rather comprehensive selection of major wetlands types is included in the Ramsar List, especially for the Western Palearctic region. A Directory to sites on the Ramsar List is maintained by IUCN's Protected Areas Data Unit which details both biological and physical features of interest for each site. Furthermore, efforts have been completed by IUCN and IWRB to develop a comprehensive Directory to wetland areas in Latin America as well as by IUCN and UNEP for Africa. It is also planned that in the near future a similar project will be carried out by IUCN, IWRB and ICBP for Asia. The data from these directories will be used to spotlight areas for future coverage under the Convention, in shadow list publications.

It should finally be noted that Ramsar sites may encompass very large areas. Although on accession in January 1981 Canada designated a relatively small site covering 2200 hectares, it later announced the addition of 14 more sites covering some ten million hectares. Mauritania upon its accession in October 1982 designated a site of 1,173,000 hectares. A third example can be seen with the USSR designating 12 sites totalling 1,207,800 hectares.

Values of the Convention Perceived by the Contracting Parties

National reports on the implementation of the Convention are submitted to Conferences of the Contracting Parties. These provide an interesting overview of the values that the Contracting Parties have attached to the Convention. Italy has indicated that its general national policy on wetland conservation has been based on the elements of the Convention and that the Convention has stimulated active conservation collaboration between its Central Government and Regions. Hungary has noted that the Convention provides important impetus for States to cooperate for wetland conservation and as a result has urged that efforts be made to encourage its neighbour, Rumania, to accede to the Convention and designate the Danube Delta for the List, in order to facilitate its own national wetland conservation efforts. Norway has also said that the Convention has provided the basis for its national wetland conservation policy, with particular attention being given to preparing wetland inventories, ensuring the protection of a network of wetland reserves, and the prevention of degradation of wetland habitats. The Swedish Government has commented that the Convention has increased national interest in wetlands, spotlighted their importance both nationally and internationally and promoted the concept that migratory waterfowl are an international asset.

Reports from the Contracting Parties have also stressed the value of the Convention in helping to prevent detrimental changes to sites included in the List. Examples include a reduction in the area to be affected by harbour extentions in the Wadden Sea between the Federal Republic of Germany and the Netherlands due to the designation of Ramsar sites in the region, the reversal of drainage orders within the Colfiorito Marsh, a Ramsar site in Italy, the cessation of commercial fisheries in Lake Haleji, a Ramsar site in Pakistan, and the rejection of proposed plans to sink a stricken oil tanker close to the Minsmere-Walberswick Ramsar site in the United Kingdom.

Future Initiative Planned Under the Convention

Despite the positive examples given above, it must be recognized that the Ramsar Convention has not been fully effective due to certain inherent weaknesses. Most significant has been the absence of administrative provisions. Indeed, in 1980 the World Conservation Strategy assessed the Convention by noting: experience has shown that an international Convention must have a (permanent, secure) secretariat and financial mechanism to be effective. But the Wetlands Convention lacks both. Furthermore, when adopted, the Convention did not have an amendment procedure, which frustrated efforts to address its deficiencies. Another problem had been the presence of and unfortunate final clause establishing English as the only authentic language thereby posing a serious political difficulty for participation by certain States, French and Spanish speaking countries in particular.

Happily the Contracting Parties are taking steps to remedy these problems - but the process is lengthy. In December 1982 an Extraordinary Conference of the Contracting Parties was held in Paris, wherein a Protocol was adopted, providing for an amendment procedure and additional official language versions of the convention. The Protocol will enter into force upon its acceptance of two-thirds of the Contracting Parties as of the time of its adoption in 1982. As of 1 July 1985 action by only three more States is required, all Arctic Contracting Parties with the exception of the USSR have accepted the Protocol.

In anticipation of the entry into force of the Protocol, the Second Conference of the Contracting Parties (Groningen,1984) established a Task

Force under the Chairmanship of the Netherlands with representation from Canada, Denmark or Sweden, Poland, Senegal and Tunisia to develop amendment proposals to the Convention providing for

1. a financial basis for the Convention,
2. secure permanent secretariat arrangements and
3. other administrative improvements concerning the functioning of Conferences of the Parties

The Task force met in May 1985 and its findings are now being forwarded to the Parties for adoption, it is anticipated, at the Third Conference of the Contracting Parties to be held in Regina, Canada, in late spring 1987.

The Regina Conference will not only be devoted to the legal niceties of Convention amendments. A major focus will be given to technical requirements for wetland conservation and management in several scientific workshops. Particular attention will be given to the need for international cooperation for wetland areas and the species dependent upon them in the Western Hemisphere. Similarly, of special relevance to the Arctic States, stress will be placed upon the Canadian situation for wetland conservation. In the near future, IUCN will be issuing invitations in the name of the Canadian Government to all Contracting Parties, all other States, and to concerned governmental and non-governmental organizations.

Involvement of the Arctic States in the Convention

The Arctic States play a crucial role under the Ramsar Convention. As noted above, they are all Party to it, with one exception (USA) and that country is now in the process of joining. They all have extensive wetland areas of international importance both in economic terms and in providing habitats for countless species. All, including the present non-Party State, have been active in international wetland conservation measures and all have strongly supported and promoted the Ramsar Convention.

Nevertheless, more could be done by the Arctic States to take fullest advantage of the Convention, in particular by including additional sites onto the List of Wetlands of International Importance.

Of all aspects of the Convention, the List has attracted greatest international attention. Public recognition of the global importance of listed sites has been responsible for significant conservation actions and hence listing under the Convention has become an important conservation tool.

A cursory look at the list of Wetlands of International Importance indicates that many more sites could be added by the Arctic States. The following sites beyond at least 60° N latitude have been designated under the Convention (less that 10% of the listings under the Convention):

Canada

- Whooping Crane Summer Range (60° 15'N, 113° 15'W)
- Old. Crow Flats (67° 34'N, 139° 50'W)
- Polar Bear Pass National Wildlife Area (75° 45'N, 98° 40'W)
- Queen Maud Gulf Migratory Bird Sanctuary (67° 00'N, 102° 00'W)
- Rasmussen Lowlands (68° 00'N, 93° 30'W)
- McConnell River Migratory Bird Sanctuary (61° 07'N, 94° 03'W)
- Dewey Soper Migratory Bird Sanctuary (64° 14'N, 76° 32'W)

Denmark

- No Arctic sites designated in either Greenland or the Faroe Islands.

Finland

- Aspskar Nature Reserve (60° 16'N, 26° 25'E)
- Soderskar Bird Sanctuary and Langoren Nature Reserve
  - (Soderskar 60° 07'N, 25° 25'E and Langoren 60° 08'N, 25° 30'E)
- Valassaaret and Bjorkogrunden Bird Sanctuaries
  - (Valassaaret 63 25'-28'N, 21 01'-08'E and Bjorkogrunden 63 21'-23'N, 21 02'-09'E)
- Krunnit Nature Reserve (65° 21'-26'N, 24° 25'-25° 09'E)
- Ruskis Nature Reserve (60° 22'N, 25° 40'E)
- Viiki Nature Reserve (60° 13'N, 25° 00'E)
- Suomujarvi-Patvinsuo State Nature Reserve (63° 05'N, 30° 35'E)

- Martimoaapa-Lumiaapa (65° 49′N, 25° 15′E)
- Koitilaiskaira (67° 40′-50′N, 26° 50′-27° 41′E)

Iceland

- Myvatn Region (65° 40′N, 17° 00′W)

Norway

- Akersvika Nature Reserve (60° 50′N, 11° 08′E)

Sweden

- Annsjon (63° 16′N, 12° 33′E)
- Lako Gammelstadviken (65° 38′N, 22° 00′E)
- Lako Persofjarden (65° 47′N, 22° 09′E)
- Tarnasjon (66° 00′N, 15° 19′E)
- Lake Tjalmejaure-Laisdalen Valley (66° 15′N, 16° 11′E)
- Lake Laidaure (67° 07′N, 17° 45′E)
- Sjaunja-Kaitum (67° 17′N, 19° 49′E)
- Taavavuoma (68° 30′N, 20° 45′E)

USSR

- Kandalakcha Bay (66° 45′-67° 08′N, 32° 30′-34° 05′E)

Given the importance accorded to wetland conservation by the Arctic States it would appear strange that more has not been done in listing sites under the Ramsar Convention. Indeed, the matter has been discussed at meetings of the Conference of the Parties. In Recommendation 1.3 of the First Conference of the Parties (Cagliari, 1980), it was determined that in order to achieve the aims of the Convention, Contracting Parties should designate as many as possible of their wetlands of international importance for the List. The Conference therefore called on Contracting Parties to increase the number of wetlands in their territories to be included in the List, particularly as regards sites outside the western Palearctic and wetland types poorly represented in the western Palearctic. Wetland types poorly represented in the western Palearctic had been identified as tundra, peatlands, wet meadows, tidal estuaries and southern wintering areas for waterfowl.

The question of Arctic coverage was again considered at the Second Conference of the Contracting Parties (Groningen,1984) where it was noted that no further wetlands of this type in the western Palearctic region had been designated since Cagliari, although coverage for the Arctic in general had been greatly increased due to the accession of Canada to the Convention in 1981 and the subsequent listings made by the Canadian government.

The main reason cited for the paucity of Arctic site designation has been the apparent inapplicability in the Arctic of the agreed upon Cagliari criteria for the determination of what constitutes a wetland of international importance. The report from Finland to the Cagliari Conference noted that the Cagliari numerical criteria developed for passage and wintering waterfowl populations are not applicable for breeding populations in boreal regions, since very few sites can include a significant proportion of the total breeding population of a wetland species. Consequently, an evaluation system based on diversity was being developed in Finland.

Similarly at Cagliari, the Norwegian delegation said many of its important Arctic wetlands were already protected, though not designated for the List because of difficulties with selection criteria. It noted that if appropriate criteria could be adopted, Norway would designate more sites.

Following the Cagliari Conference, cooperation was instituted among the Nordic countries to develop recommendations for the interpretation and expansion of the Cagliari criteria in view of the specific wetland conditions in the northern countries. This work has recently been completed and was reported on at the Groningen Conference.

The delegation of Finland informed the Conference that for the purposes of developing inventories of sites in Finland, wetlands had been divided into peatlands, eutrophic lakes and sea bays. Inventories of peatlands had been made by 1979, and a peatlands conservation program had been instituted.

Inventories of eutrophic lakes and sea bays were completed in 1981, and by 1982 decisions had been made in principle concerning the conservation of these areas. Some 600 peatland sites had been identified along with 300 sea bays and eutrophic lakes.

Finland further indicated that designation of additional areas to the Ramsar List was under consideration, involving 10 bays covering 21,000 hectares and 17 inland lakes covering 13,000 hectares.

The Icelandic National Report to the Groningen Conference mentioned Iceland's involvement in the Nordic working group on criteria for the selection of wetlands of international importance. It noted that the Ramsar Convention and its obligations constitute an essential point of reference when placing priority on sites selected for national as well as international protection.

However, Iceland reported that it will take several years to ensure that legal reserves are declared on all sites considered of international importance since out of a possible 30 wetland sites of international importance in Iceland only one had to date been placed on the Ramsar List.

The delegation of Norway reported to the Groningen Conference that in 1974 Norway had 20 wetland reserves, in 1980, at the time of the Cagliari Conference 107 and at present 346. On the basis of the Cagliari criteria, refined criteria had been drawn up for the Nordic countries, and further detailed national criteria had been developed. This had led to the development of a first list of Norwegian wetlands of international importance. It was therefore announced that Norway was not ready to add eight more sites covering about 14,000 hectares to the List. (Author's note: Following the production of this paper, Norway designated eight new Ramsar Convention sites north of 60° covering some 8,000 hectares.)

The Swedish report to the Groningen Conference also referred to Nordic cooperation for the further elaboration of criteria for identifying wetlands of international importance. The report expressed the hope that these new criteria would facilitate the designation of additional Swedish sites for the List.

Finally, the reports of Canada and the Soviet Union to the Groningen Conference are also indicative of the approach now being taken to increase the establishment of Arctic wetland reserves pursuant to the Convention. The Canadian report noted that in the Canadian context, there will never be a complete network of listed sites. Rather, designation is considered an ongoing process of site-specific protection and of publicizing the environmental and economic values of all wetlands. A major consideration is to promote, through example and moral persuasion, an ethic of wetland conservation. The Canadian approach to the implementation of the Convention is part of a broader cooperative program involving the public and private sectors, to stem the continuing degradation and loss of wetlands.

The Soviet Union reported that, since 1976, new wetlands have not been added to the List. However, 22 more wetlands (with a total area of 2,976,000 hectares) which answer the criteria of wetlands of international importance as waterfowl habitat have been identified and taken under protection.

- Orlandet Wetland System	63° 42′ N 9° 35′ E
- Tautra and Svaet Nature Reserve	63° 35′N 10° 37′ E

- Stabbursneset Nature Reserve 77° 85′ N 4° 22′ E
- Forlandsoyane Bird Sanctuary 78° 20′ N 11° 36′ E
- Dunoyane Bird Sanctuary 77° 04′ N 15° 00′ E
- Kongsfjorden Bird Sanctuary 78° 55′ N 12° 10′ E
- Isoyane Bird Sanctuary 77° 08′ N 14° 48′ E
- Gasoyane Bird Sanctuary 78° 20′ N 11° 36′ E

Conclusion

Following a difficult adolescence, the Ramsar Convention is coming of age. This first modern global conservation convention has the potential to do what no other existing conservation convention can do - foster cooperation to ensure the conservation of particular extensive habitats and the species found therein. The Contracting Parties are demonstrating their determination to make the Convention a success.

In particular, the process is underway to amend the administrative deficiencies of the Convention and a major technical Conference on wetland conservation requirements is being organized under the Convention in Canada in spring 1987.

Significantly, following the adoption of additional official language versions of the Convention and a growing international recognition of the importance of the Convention, many more countries are expressing interest in becoming Contracting Parties. For instance, IUCN and IWRB have recently been in contact with many States which have indicated their intention to join the Convention. Overtures by Argentina, Angola, Botswana, the Central African Republic, China, Costa Rica, Czechoslovakia, Egypt, Indonesia, Israel, Ivory Coast, Kiribati, Panama, Paraguay, Peru, St. Lucia, Sri Lanka, Sudan, Thailand and Venezuela are indicative of an increased interest in the Convention throughout the world.

The Arctic States have a key role to play under the Convention, both because of their wealth of wetland areas, and because of the example they can provide to States in other parts of the world. They must continue to be in the forefront for international wetland conservation measures. Increased utilization of the Ramsar Convention and designation of additional sites to the Ramsar List should be promoted among the Arctic States. With continued goodwill from the Contracting Parties and with the involvement and assistance of other conservation-minded States and organizations, the important objectives of the Convention can be achieved.

The opportunity should be seized to expand the use of the Ramsar Convention to help conserve wetland areas. The time to act is now.

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Whither Arctic Marine Conservation? A Review of Five Perspectives

Terry Fenge

Introduction

The five papers in this session fall neatly into two groups. VanderZwaag and Lamson, and Mitchell, deal with marine and coastal zone planning and management in northern Canada and Alaska, while Lapointe, Navid, and von Droste tackle international arrangements to conserve the Arctic. The first two papers outline how we manage the arctic marine environment and both call for a more rational and comprehensive approach to decision making through land-use and resource-use planning. The remaining papers suggest that international arrangements to conserve arctic species of wildlife and their habitat should receive greater attention from the circumpolar nations.

Planning and Managing the Arctic Marine Environment

VanderZwaag and Lamson provide a clear description of shipping management in Canada's northern marine environment. Having noted the all too numerous committees and boards that deal with these matters, they conclude:

> The Canadian government is faced with a number of major arctic service policy questions which require decisions based on long-term planning, as opposed to short-term economic or political considerations (VanderZwaag and Lamson, this volume).

They forsee significant environmental risks with increased northern shipping in the 1990s and beyond, and suggest that a "framework for adequate environmental protection" is urgently required. They imply that the existing plethora of boards and committees will be unable to deal adequately with the environmental impacts of shipping. This conclusion may be correct, but the authors do not substantiate it with an analysis of the efficiency or effectiveness of existing institutions and management arrangements for arctic marine shipping. Many readers will accept the call for more and better planning and management in the arctic environment, but more discriminating readers will want to know what is wrong with existing project assessment processes handled by the National Energy Board (NEB) and the Federal Environmental Assessment Review Office (FEARO) and shipping management under the Arctic Waters Pollution Prevention Act and the Canada Shipping Act before endorsing major reforms. For example, the authors might have told the curious tale of Panarctic's Bent Horn project to substantiate their contention that decision making for arctic marine shipping and non-renewable resource development needs to be overhauled. This small scale "demonstration" project is now producing and transporting crude oil from Cameron Island in the High Arctic to Canada's east coast. Yet the project went ahead, in 1985, only after the federal Cabinet passed on order in council relaxing the shipping regulations under the Arctic Waters Pollution Prevention Act to allow the *M.V. Arctic* into the ice-infested waters off Cameron Island to pick up the oil. The *M.V. Arctic*'s ice-class rating is based on hull strength, motive power, and other factors. Under the shipping regulations, the *M.V. Arctic* should not be allowed to transit this portion of the high arctic. This capricious decision-making supports VanderZwaag and Lamson's conclusion that existing management arrangements need reform.

Having sounded an alarm by stressing the "urgent" need for an *environmental framework* in the North, VanderZwaag and Lamson call for "fine tuning" of the existing environmental management system. They recommend that procedures for reviews of proposed projects by NEB and under the Environmental Assessment and Review Process (EARP) be "clarified" and put into regulations. They also look forward to northerners assuming greater roles in resource-use decisions making. This, they assume, will evolve from settlement of land claims, further political development in the territories, and implementation of the long-stalled Northern Land Use Planning Policy. Certainly, northerners are prising open federal decision making through these forums. But the authors leave two key questions unanswered: what is an adequate environmental framework for marine and shipping management in the Canadian North, and what authority should northerners have in implementing such a framework?

The discussion of the legal regime of the northern offshore, with particular reference to the Northwest Passage, is handled well, and non-lawyers will be thankful for this treatment. This topic is very timely given the uninvited transit of the of the Northwest Passage in 1985 by the US Coast guard vessel *Polar Bear*. VanderZwaag and Lamson (this volume) suggest, reasonably, that:

> Canada might wish to clarify the status of the Northwest Passage through a series of bilateral agreements which would grant foreign navigation access in return for recognition of Canadian sovereignty and corresponding environmental management rights.

On 10 September 1985 the Minister of External Affairs, the Right Honourable Joe Clark, made a policy statement in the House of Commons on this issue that follows closely VanderZwaag and Lamson's advise.

Strangely, Inuit use of marine resources is dealt with cursorily in this paper, but if and when the question of sovereignty over the Northwest Passage is argued before the International Court of Justice at the Hague, Inuit harvesting of marine mammals and their occupancy of the Arctic since "time immemorial" may be Canada's trump card. As Mark R. Gordon, Canadian vice-president of the Inuit Circumpolar Conference and president of Makivik Corporation, said recently:

> We fish, we hunt, and we can exist on this water for a great part of the year. When it is int its liquid state in the summer we can still travel on the water. Use and occupancy does not necessarily mean an oil rig. Look at all the places around the world where they don't have oil rigs and they have sovereignty. I don't believe that Canada has to bring white people to the North to say that it's Canadian. We'll hold the flag up there for you (Gordon, 1985).

Mitchell's paper deals with both American and Canadian approaches to marine and coastal zone management in the Arctic. For anyone who expects to find political similarities between Canada and the USA, his paper will be an education. The bureaucratic, adversarial, and litigious approach to resource management in Alaska is eschewed in northern Canada. According to Mitchell (this volume):

> The United States relies on formal administrative programs and supporting legislation to regulate offshore development and coastal management. Canada prefers to set coastal and marine issues within broader agency responsibilities, to base policy on loose advisory relationships among agencies, and to give Cabinet ministers paramount authority in decision making.

Mitchell sees conflict among and between private interests and government agencies as the norm in policy and decision making in Alaska, following the pluralist model so beloved by American political scientists. Moreover, he makes much of inter-agency competition and disputes as part and parcel of decision making. Canadian civil servants and politicians are steeped not only in American models of policy making but also in British approaches in which overt conflict is avoided as much as possible. Yet the inter-agency conflict with which Mitchell is so familiar has its counterpart in intra-agency conflict in Ottawa. For example, the all-encompassing mandate to the Minister of Indian Affairs and Northern Development leads to considerable disagreement between civil servants within this department who must try to balance aboriginal interests with environmental conservation and development of non-renewable resources. Conflict is probably just as much a part of the Canadian decision-making system as it is of the American, but Canadian decision makers are less likely and less able to bring conflict into the open. With fewer investigative journalists and interests groups in Canada to lay bare the messy details of disagreement, Canadians rarely hear about the conflict that is inherent in their policy system.

The need for a more rational and integrated approach to marine and coastal zone management is Mitchell's main message. He does not seem to go too far by advocating "totally integrated management program that orchestrates all sectors of human activity in both the marine and terrestrial environments (Mitchell, this volume). Regional planners and political scientists will sagely approve this advice, but politicians and civil servants, most of whom are immersed in less academic semantics, will want to know what this means and to satisfy themselves that it does not have Orwellian implications. Mitchell's basic point is sound, for we need to manage coastal and marine areas together in recognition of the ecological interdependence of arctic lands and waters. But if we are to get politicians and civil servants to do this, we must find straightforward ways to explain why and how it should be done.

Cooperation among circumpolar nations in many environmental and research fields is growing, and the academic community can justly claim to be promoting such endeavours. However, neither VanderZwaag and Lamson, nor Mitchell, mention the Inuit Circumpolar Conference (ICC), which is the most innovative and has the potential to become the most important example of cooperation among residents in circumpolar lands. This loosely-knit and underfunded organization brings together Inuit in Alaska, Canada, and Greenland to deal with economic, social, environmental, and political issues of common concern. If solidarity among native peoples can survive the tests ahead, the ICC could become an important factor in decision making. Already ICC's representatives have criticized bitterly the ad hoc and incremental way in which resource use decisions are made in the Alaskan and Canadian Arctic. Both the ICC and regional aboriginal peoples' organizations in Alaska and Canada are key supporters of the integrated and planned resource management that VanderZwaag and Lamson, and Mitchell, advocate.

In Canada, at least, it is the aboriginal peoples' organizations, not federal government agencies, that are promising new models to integrate natural resource management according to conservation principles. The academic community should devote more attention to these proposals, for the aboriginal peoples' organizations are on the cutting edge of institutional development.

Hon. Thomas R. Berger recently presented to the ICC his review of the implementation of the 1971 Alaska Claims Settlement Act (Berger, 1985). The continuing importance of the subsistence economy in village Alaksa is highlighted in this report and through its often eloquent passages comes a message that, to native peoples, environment and conservation are not just technical terms but lie at the core of their economy. This bears repeating, for Mitchell notes that senior government agencies in Alaska downplay the economic interest that native peoples have in their natural environment:

> although the state recognizes that subsistence usage of coastal areas deserves special protection, municipalities are cautioned not to use subsistence area designations to block economic development activities (Mitchell, this volume).

The subsistence economy of native peoples is often hidden from the prying eyes and sharpened pencils of academics, but it remains of fundamental economic importance to many native peoples who do not intend to transfer their allegiance lock, stock, and barrel to the frontier industrial economy. Acknowledging the subsistence economy is not sufficient. Native peoples must have the authority to plan for its enhancement.

An International Perspective on Arctic Marine Conservation

Canada is a vigorous supporter of the United Nations and the various bodies set up under it to foster international cooperation in economic, social, environmental, and cultural affairs. True to this outgoing nature, Canadians have generally welcomed international efforts to conserve wildlife and wildlife habitat. Some of these effects are outlined in the papers by Lapointe, Navid, and von Droste.

There is a growing sentiment among native northerners that the importance of their hunting, fishing, and trapping economy is poorly appreciated by the members of the environmental jet-set who advocate international conservation arrangements. Lapointe describes the growing international acceptance and use of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and outlines how proposals to ban international trade in narwal and gyrfalcon were dealt with at the CITES convention in Buenos Aires in 1985. The northern Canadian delegates at this convention returned home convinced that CITES was being manipulated by European nations more interested in politics than rational environmental management, and that few delegates appreciated the fundamental economic importance of wildlife harvesting to native peoples. Native peoples see well-funded and slickly advertised attacks on their subsistence economy by the anti-harvesting lobbies led by Greenpeace. They look to their national governments and international organizations for solace and support, and are greatly disappointed by the vacillating and inadequate response. They feel CITES, as one of the most visible international conservation tools, is being misused, and that they are the sacrificial lambs being led to the international conservation altar. It may not be long before those who implement CITES and other international conservation arrangements will be accused of cultural genocide by northern native peoples.

The Ramsar convention, discussed by Navid, deals with wetlands, which, in the Arctic, provide habitat for many species of birds that migrate annually to more temperate lands. Native peoples in northern Canada suspect that these birds are being preserved for the exclusive use of recreational hunters further south. The 1916 Migratory Birds Convention between Canada, the United States, and Mexico, and the 1917 Migratory Birds Convention Act, prohibit hunting of migratory birds between 10 March and 1 September, the only period of the year that migratory birds are found in the North (Fenge *et al.*, 1979). Native peoples have ignored this international conservation arrangement and in so doing have clashed with wildlife biologists and government regulators (Cumming and Aalto, 1974). Those who implement the Ramsar convention should draw a valuable lesson from this case. Navid notes that relatively few wetland sites in the Arctic have been designated under the Ramsar convention due to the 'inapplicability' here of criteria used elsewhere in the world to determine which wetlands are internationally important (Navid, this volume). Much time and effort has been spent in Canada to develop objective and measurable criteria to identify and evaluate areas for conservation reserve status. Standard criteria have yet to be chosen, and judging by the 1984 report of the Canadian Northern Conservation Task Force such criteria will never be found (Task Force on Northern Conservation, 1984). Lack of criteria could become a perpetual excuse for inaction.

Navid concludes that Ramsar is an effective conservation tool that will probably grow in importance. To support this position he quotes a recent Canadian government report on implementation of Ramsar in Canada:

> in the Canadian context, there will never be a complete network of listed sites. Rather, designation is considered an ongoing process of site-specific protection and of publicizing the environmen-

> tal and economic values of all wetlands. A major consideration is to promote, through example and moral persuasion, an ethic of wetland conservation. The Canadian approach to the implementation of the Convention is part of a broader cooperation program involving the public and private sectors, to stem the continuing degradation and loss of wetlands (Navid, this volume).

To those who are not encumbered by the need to be diplomatic, this statement seems more a call to inaction than a wholehearted endorsement of Ramsar. Protection and preservation of key wetland habitats in the North is a most worthy goal and Ramsar should promote this.

Bernd von Droste deals largely with implementation of the Man and the Biosphere Programme (MAB) and the World Heritage Convention. The former program stresses how man functions in the natural environment, and how a more stable and sustaining balance between man and environment can be achieved. As such, it is a program of great relevance and interest to northern native peoples. The recently formed Northern Science Network, which operates under the auspices of MAB, is also an important initiative that should bring academic and government researchers together with native peoples who reside in the North year-round.

Various sites in Canada are listed under the World Heritage Convention and each sports a shiny plaque to commemorate its designation by one or more royal personages active in the wildlife conservation movement. But what does such a designation really mean and how seriously do national governments take the convention? Von Droste comments upon the long and bitter confrontation between the Commonwealth and State governments in Tasmania over plans to dam the Franklin River, listed as a world heritage site. In this case, the heritage status gave the Australian commonwealth government a trump card to play in favour of conservation. The World Heritage Convention was of great importance in the preservation of the site. Von Droste neglects to cite instances where heritage status under the World Heritage Convention has provided little additional protection to a conservation area. For example, Kluane National Park Reserve in the Yukon and the adjoining Wrangell-Saint Elias National Park in Alaska were awarded world heritage status in 1980, but this did not prevent presentation of bills in the American congress by Alaskan senators to downgrade much of the Alaskan national park to allow sport hunting in it (Wayburn, 1983).

All too often, international conservation efforts seem shrouded in the niceties of diplomacy and measured language, the aim being to avoid conflict between various parties. This is how it will and should remain, but at gatherings such as the Arctic Heritage Symposium we must go beyond these niceties and evaluate rigorously whether international conservation efforts are working. Neither Lapointe, Navid or von Droste accepted this challenge.

Post Script

A proprietary attitude of academics and government researchers toward arctic environmental and heritage conservation is implicit in many of the papers presented at this symposium and in much of the discussion of the papers. We have heard a representative of the Canadian Wildlife Service talk of 'his' migratory birds and migratory bird sanctuaries in the Northwest Territories, and academics portray research programs upon which they are working as their exclusive domain. This attitude perpetuates a view of the North and northerners as objects of research. Had any native people attended this symposium, surely they would have been dismayed by the proprietary attitude toward the North shown by many here. If the North can be seen as property, it belongs not to academics who grace it with their presence during the summer, nor to government regulators putting in their 'northern time', but to the area's permanent residents. It is their environment and their heritage we have been discussing. In this regard I want to end this review article by quoting John Bayly, a northerner who attended this symposium. In 1983 he offered some advice to the Canadian Arctic Resources Committee (CARC) at the conclusion of its Third National Workshop held in Yellowknife. His advice should be taken to heart by all who attended the Arctic Heritage Symposium:

> I am grateful that such a distinguished collection of Canadian and American thinkers and doers has shown, and continues to show, a sustained and sustaining interest in northern Canada. You may detect a feeling of ambivalence towards your interest and advice from some northerners. Part of this may be your manner of speaking in what John Blake of Fort McPherson calls 'twelve-cylinder words.' Northern peoples are learning the meaning of such words but they still value plain, straight-forward talk. I wish to make three suggestions before I close: First, come and give advice as soon as you see we might be having problems that your experience might assist with. Secondly, put your coveralls on; we may need your help to try out the solution you propose, and you might have to get your hands dirty. Finally, try to make sure that you understand what is going on in the North from a northern perspective as well as from a southern perspective before you venture to give your advice because things seen through our eyes look quite different sometimes (CARC, 1984).

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Comments on Land Use, Conservation and Resources Development in the Canadian Arctic

Gerry Kruk

Introduction

The papers provided for criticism covered much ground, including the alleged inadequacy of marine law and government regulation in the context of growing environmental risks resulting from increases in marine traffic and non-renewable resource development.

Many of these issues could be much better addressed by lawyers or representatives of government agencies or petroleum companies which are currently more directly involved in Arctic operations than is my own company, Shell Canada.

Therefore, less time will be wasted and discussion more effectively stimulated by drawing upon my personal experience with corporate and government operations in the Canadian Arctic in order to sketch briefly a petroleum industry perspective in environmental and social impact management. Any views expressed are purely my own.

During my remarks many of the key themes raised in the papers will be touched upon, namely:

- the concepts of risk and risk avoidance technologies
- the importance of research and its interrelationships with development and south environmental protection policies
- public participation, in particular by northerners, in environmental protection and in the benefits of development as well
- the importance of cooperation, coordination and dialogue

Factors Influencing Environmental Protection

The quality of environmental protection is a function of three factors:

Firstly, the level, pace and form of industrial or harvesting activity;

Secondly, the amount of expertise, reliable scientific data and preventative and mitigative technology available;

and thirdly, the attitude and commitment that both developers and regulators bring to the task of environmental protection. On all three grounds, Canada seems to be quite well served. Let me briefly deal with each one of the foregoing factors.

Activity

In the past decade, developers, governments, and local communities alike have learned a great deal about the difficulties associated with megaprojects. These problems have to do not only with financing, but environmental and social impacts and governments preparedness as well.

At the present time, there's a large degree of consensus on the value of smaller scale and phased development in the north. Through phased development, the large amounts of environmental and social impact research done prior to project approval can be supplemented by research and experience which is accumulated in the course of cautious, incremental development. With smaller projects, not only are there fewer and less damaging impacts on the environment, there is also more opportunity for meaningful local involvement and benefits. All this was recognized by the 1984 Beaufort EARP report, which concluded that 'there is considerable support among native people for further development of a mixed economy in the "north."

Acceptance and support of moderate well-planned development by natives is, I think, rooted as well in their awareness that even without significant industrial development, their traditional physical and biological environment is continuously changing under the influence of new transportation, communications and hunting-related technologies.

Reliable Data/Reasoned Priorities

The proper assessment and management of risk requires objective data and evidence - scientific and empirical. Decision-making based on science and research isn't as easy to achieve as it sounds. Environmental issues are complex and the stakes are often high, so that emotion frequently complicates discussion and, needless to say, settlement. Discussion is often characterized by simplified notions and polarized positions, opening the way to the potential problem of excessively rigid regulations being implemented in pursuit of unrealistic goals. Environmental concerns develop into political concerns and political considerations sometimes ignore the fact that *no* human activity has zero risk and that quick fixes are unattainable.

The public doesn't expect *miracles*, but rather and simply, *responsive* and *responsible* action.

A responsible, effective approach to environmental protection must be based on the efficient collection and application of scientific knowledge. This will permit us to focus on the real and top priority problems, on effective innovation and on realistic goals.

As Ken Mitchell pointed out in his paper "offshore oil and gas developments have *stimulated* collection of information about Arctic societies and environments at the same time as they threatened their stability." This linkage between the accumulation of development experience and relevant environmental protection data is inevitable and valuable.

Many parts of Canada's arctic have been the subject of more research and study than numerous other and more developed parts of Canada. The petroleum industry and its associations have spend about $200 million on various scientific studies of the physical, biological and social environments of the north and how its own activities could be made compatible with environmental and social concerns.

Since 1970, the Arctic Petroleum Operators Association (APOA) alone has sponsored over 200 research projects costing $60 million. The industry-financed Environmental Studies Revolving Fund undertakes further research. Pertinent to the papers presented at this panel, the oil spill committee of the APOA and the Offshore Operators Division of the Canada Petroleum Association coordinates oil spill issue analysis and research. The oil spill committee also works with the Canadian Coast Guard to field test equipment, reviews training programs as well as conducts workshops and publishs information to encourage the timely and effective dissemination of the growing body of expertise in this important field.

As well, most northern operators conduct their own laboratory research and testing of their technologies and operations in advance of actually applying them in the north. For example, when it comes to using artificial islands or steel caissons as year round drilling platforms, petroleum companies do not use the north itself as their laboratory. They recognize the north isn't barren wilderness, but Inuit homeland. The petroleum industry also takes great care that, when it actually moves its operations from the research lab to the field, it installs monitoring equipment and initiates measurement surveys which assess the actual impact of its operations and the actual performance of its equipment to ensure even further progress in developing cost effective and environmentally safe operations in the future. For example, the petroleum industry probably has acquired more valuable, scientific data on arctic ice movements and the beluga whale population than any other public or private sector agency.

Commitment

Even if a company, or any agency, is conducting small scaled, phased development and has a great deal of sound environmental data and technologies available to it, unacceptable levels of damage *may still occur* if there isn't an adequate degree of *commitment* to environmental protection, health and safety at all levels of the organization.

My own experience in the petroleum industry leads me to the conclusion that the essential commitment to environmental protection is there. Although there are, inevitably, unfortunate incidents from time to time, whether it be a relatively small oil spill, or damage to ship or drilling difficulties, a detailed review of each incident and the subsequent action undertaken by the company involved, suggests not corporate indifference, but a determination to correct the mistake and the circumstances that contributed to it, to learn from the incident and try to prevent its recurrence - in short *commitment.*

For me this determination to conduct one's northern operations in a safe, efficient and environmentally responsible manner, is a reflection not only of enlightened corporate self-interest and corporate responsiveness to the society of which it is a part, but of the professionalism of its employees as well. There is simply great professional pride in doing a challenging job safely and responsibly. These companies place much greater emphasis on being recognized nationally and welcomed locally as good, responsible corporate citizens rather than on cost cutting to maximize near term earnings. Hence most companies have not only impressive in-house environmental staffs, but they also have codes of conduct, which are not only proclaimed by top management, but integrated into the job descriptions and performance appraisals of operating personnel at all levels of the company, thereby fostering the internalization of this environmentalist ethos throughout the organization. The companies have very stringent rules, regulations and procedures designed to protect the environment and nobody gets credit for taking short-cuts. For me, another illustration of this commitment is, the way environment, health and safety issues always seem to be the first items discussed, and discussed in detail, at internal exploration and production departmental meetings.

Conclusions

In concluding, a few words can be said about existing mechanisms for reviewing environmental impacts and facilitating public participation.

Clearly, numerous mechanisms to predict, identify and manage environmental impacts are in place. From my experience, these are taken very seriously by the applicant and the regulator such that all phases of oil and gas activity in northern Canada are effectively assessed and monitored. From industry's viewpoint, the diversity of regulatory bodies often leads to unnecessary and costly duplication of review efforts. As well, industry is concerned about the amount of expensive research and documentation it must provide in EIS's without any indication its proposal has even approval in principle from the government. Greater clarification of government policy direction and priorities, improved coordination and communication between various and often competing government agencies, as well as the creation of more effective "one window" regularity regimes would be helpful in this regard.

As for public participation, the existing vehicles for environmental assessment of specific projects, and even of theoretical development "concepts," as in the case of Beaufort EARP, promotes useful and extensive consultation, communication and participation among all interested parties. Industry and government recognize the legitimate interest of local communities in norther projects, the value of the environmental and social impact expertise they can bring to bear and the role they can play in project monitoring. However, the following opinion will end my remarks.

When the public "perceives" there is an environmental problem or risk, then industry and government must give it serious attention. However, the management of risk involves three separate forms of risk: objective risk (i.e. something which is inherently testable); subjective risk (i.e. which reflects the degree of belief/faith' in empirical data); and perceived risk (i.e. based on non-technical, sometimes emotional considerations). The laws and findings of science cannot be changed by values or subjective feelings. Therefore, in order to manage risk assessment procedures effectively, it is necessary to obtain *both* public and technical participation, but *somehow* they must be addressed separately during the process in order to derive the best political solutions.

Summary of Discussion on Land Use and Conservation in the Arctic: Session III

Editors

Discussion was charged with emotions and challenges as persons from the Canadian Wildlife Service, Parks Canada, the Canadian Arctic Resources Committee and other interested groups presented their perceptions of progress and problems in regard to northern resources and environmental planning and management in northern Canada in particular. Disagreement ranged over issues such as: the means of identifying special areas and the way they should be managed; the number of parks and protected areas created; the rate of creation; the role of various agencies, the native people and southern public; appropriate uses in special areas; native use and rights; and the extent of effective national and international cooperation. Several discussants indicated that the manoeuvering was a reaction of public and private actors and agencies faced with the complexity and enormity of the northern resource and environmental management task. The task was described as being without the necessary information, institutional and legal means.

After further discussion of marine and coastal management; the various problems posed by petroleum, mining and other development; and the effectiveness and implications of Ramsar, CITES and other international agreements as well as the Law of the Sea and the UNEP Regional Seas program, several foci of concern arose. A call was made for (i) the comprehensive examination and evaluation of international, regional and national conventions and agreements in the area of wildlife management, coastal and marine management, pollution control, and park and related reserve systems; (ii) the strengthening of international exchange programs for northern experts from the scientific, academic and managerial communities; (iii) assessment of the potential success of a network of circumpolar universities; (iv) the study and improvement of individual actor and agency responsibilities in the realm of Arctic heritage conservation; (v) development of means whereby local people and their values and expertise can play a stronger and more consistent role in all matters relating to Arctic use and conservation.

Hoodoos on Borden Peninsula, Ellesmere National Park Area, NWT
Courtesy: Murray McComb

NATIONAL PARKS AND PROTECTED AREAS IN THE ARCTIC: NATIONAL OVERVIEWS

Fort Conger, Ellesmere Island
Courtesy: F. Rennie

National Parks and Protected Areas in the Arctic: Alaska

R. J. Stenmark

Alaska is the only state or region of the United States extending into the Arctic. The state covers approximately 151.9 million hectares of land and inland waters and has an extensive continental shelf. Today, Alaska is an active state with a population of over 520,000 people and a healthy economy. About half of its people live in the Anchorage Municipality.

Approximately 54.8 million hectares of Alaska have been reserved in national conservation system units. About two-thirds of this acreage may be considered to be in the "Arctic" or in areas of arctic like conditions. This paper briefly addresses the history of conserving arctic heritage in Alaska.

Very little government reached into Alaska for years following its acquisition from Russia in 1867. No immediate efforts took place regarding heritage conservation as we think of that term today. However, the forerunner of Sitka National Historical Park was set aside by Presidential proclamation as a public park in 1890. Early in 1892, Afognak Island was set aside as a Forest and Fish Culture Reserve and later became part of the Chugach National Forest. The United States' two largest national forests - the Chugach and Tongass - were designated in 1907 because of fears of exploitation and the desire to assure wise use of the forests of southeastern Alaska along the Gulf of Alaska coast.

During the nineteenth and twentieth centuries, the populations of northern fur seal had been decimated to a point of considerable concern. An international convention in 1911 introduced conservation measures regarding pelagic sealing and protected beach areas of the Pribilof Islands where only controlled harvests of the fur seal would take place. Highly visible seabird and marine mammal concentrations prompted designation of several small islands or island groups as national wildlife refuges along the southern coast in 1909, and 1912, and in the Aleutian Islands in 1913.

Not until the establishment by Congress in 1917 of the Mount McKinley National Park was a major tract of ground set aside purposely to preserve an area for its outstanding wildlife, scenic and other natural values. A year later in 1918, Katmai National Monument was proclaimed, thereby setting aside an area made famous by the 1912 eruption of Novarupta Volcano and the Valley of Ten Thousand Smokes. In 1925, Glacier Bay National Monument was proclaimed to protect an area of outstanding scenery, bays, fjords, and dramatic expression of vegetative succession following a rapid retreat of great tidewater glaciers.

Additional wildlife refuges followed to protect brown bears, seabirds, marine mammals, waterfowl, the great Kenai moose and other wildlife and their habitats. A major area was established about every 10 years including the nearly nine million acre Arctic National Wildlife Range in 1960 bordering the Arctic Ocean and the Yukon Territory. This refuge was to protect the highest section of the Brooks Range and a major segment of the caribou calving area and other habitat of the Porcupine caribou herd shared by Canada and the United States.

During this period of time, Alaska's population was small. Most commercial activity followed the salmon. Gold rushes waxed and waned. Tourists to Alaska largely saw and visited coastal areas except for hardy adventurers and hunters who boated or flew to the more remote areas of Alaska. Two means of transportation eventually made large portions of southern Alaska somewhat accessible. The Alaska Railroad, completed in 1920, provided access from Seward to Anchorage, Mount McKinley National Park, and Fairbanks. A hotel was opened at the park in 1939 to facilitate park visitation. During World War II, the Alaska Highway (Alcan Highway) was constructed by the military to provide surface access from the lower 48 states across Canada to Fairbanks in Alaska.

Administrative staffs of the conservation units were small during the decades prior to 1960. Visitation was relatively light but grew steadily at areas with access. Management issues before the 1960s were less complex than now and some actions taken in the earlier decades were contrary to what we think is proper these days, e.g. wolf control in parks to protect ungulates.

During the 1930s, a road was extended across a section of Mount McKinley National Park for a total of 140 kilometres. This major facility for park visitors provides the opportunity to observe the park wildlife and a closer look at Mount McKinley. In 1956, this road was connected to the rest of the Alaska highway system. Visitation increased measurably.

In 1959, a new era began in Alaska with the advent of statehood. Congress provided the 49th state with a general grant of over 41.3 million hectares of the public domain to use for state purposes. Earlier territorial land grants and other special grants of the Statehood Act and subsequent laws have swelled the State's land entitlement to about 42.9 million hectares plus many millions of hectares of tidelands and submerged lands out to the three mile limit off the coast. Alaska also received title to the beds of inland navigable waters. The state began a slow and methodical selection of the vacant, unreserved, and unappropriated lands that would provide a resource base for economic development, community development, land disposal and other activities that develop a healthy state. State growth during the 1960s was slow and while state government was not wealthy, it expanded governmental operations in all aspects including wildlife management and the establishment of a state park system which includes some of the largest state parks in the United States.

Oil and gas were known to exist in several areas of Alaska from early in the twentieth century, but production had been very limited. During the late 1950s substantial finds of oil and gas were located in upper Cook Inlet and on the Kenai Peninsula. Production began onshore and offshore with substantial effects on growth and development in the area and government funding. Oil and gas exploration in Alaska expanded as a result with a major focus on the arctic coastal plain. In 1968, the Prudhoe Bay oil field, a super giant, was confirmed with an estimated 9 billion plus barrels of recoverable oil.

Besides statehood, State land selection and oil exploration, another issue was gaining momentum. Congress had continually left the question of aboriginal land claims for another and better day when perhaps the issue would be clearer or better defined. This day was fast approaching. In the mid-1960s a Federal Commission for Economic Development in Alaska addressed Native land claims in detail. Alaska Natives were concerned about State land selections being made around villages, and could observe other events taking place that could alienate the lands around them, affecting their lifestyles and subsistence resources. They began to press the issue and the Secretary of the Interior effected land freezes in the public domain in 1968 and 1969 to safeguard Native claims in Alaska lands until the Congress acted.

Congress did act and in December 1971, the Alaska Native Claims Settlement Act (ANCSA) was signed into law. This act laid the framework for the greatest land and resource allocation in the United States since the Homestead Acts of the 1800s and the Forest Reserve Act of 1891. The ANCSA provided for several state and national concerns. It provided to Alaska's Eskimos, Indians and Aleuts approximately 17.8 million hectares of land on and about the Native villages or as close thereto as possible. Over 900 million dollars also went to Alaska Natives through their corporations also established by law. Enactment of the law assured the transportation by pipeline of the Prudhoe Bay oil across 800 miles of Alaska to the ice-free port of Valdez on the southern coast. Reacting to comprehensive planning concerns, conservation group interests in Alaska lands, and other planning efforts to establish new parks or wildlife refuges in Alaska, the law directed that up to 32.3 million hectares (80 million acres) of land be withdrawn by the Secretary of the Interior for study and recommendations as to possible new or expanded national parks, wildlife refuges, wild rivers, and national forests.

For the next several years, numerous studies of all kinds led to the land selections of the Natives, the selection of the lands remaining in the state's entitlement, the withdrawal and refinement of areas for proposed conservation system units and identification of areas of developable resources such as minerals, timber, cultivable soils, and salmon spawning areas of concern to other state and national constituencies. There was considerable overlapping of interests as well as rhetorical exaggeration and perhaps some understatement as to the value of particular lands and resources. Overlapping interests were gradually resolved for the most part. For the first time, comprehensive inventories of resources of Alaska were developed into usable and available form. They clearly showed, however, that the qualitative and quantitative information available regarding resources varied greatly from one area to another.

Congressional action on the Alaska national interest lands moved slowly after the initial recommendations to the Congress by the Administration in December 1973. After several years of committee hearings, extensive public testimony, considerable deliberation by committees and the full House and Senate, and parliamentary and political manoeuvering to prevent passage of or to improve the legislation, the Congress passed an act in 1980. On 2 December 1980, President Jimmy Carter signed the Alaska National Interest Lands Conservation Act (ANILCA) into law (P.L. 96-487).

ANILCA like the ANCSA had related issues to address as well, so it includes several provisions regarding State lands, submerged lands, several amendments to ANCSA, ratifies some land exchanges already agreed to in principle, and established an Alaska Land Use Council to assist in implementation of the Act. ANILCA, however, established or expanded conservation system units (CSU) in Alaska in a comprehensive manner.

These areas contain for the public benefit nationally significant natural, scenic, historic, archaeological, geological, scientific, wilderness, cultural, recreational, and wildlife values. Congress expressed as one of the purposes of ANILCA:

> It is the intent of Congress in this Act to preserve unrivaled scenic and geological values associated with natural landscapes; to provide for the maintenance of sound populations of, and habitat for, wildlife species of inestimable value to the citizens of Alaska and the Nation, including those species dependent on vast relatively undeveloped areas; to preserve in their natural state extensive unaltered arctic tundra, boreal forest, and coastal rainforest ecosystems; to protect the resources related to subsistence needs; to protect and preserve historic and archaeological sites, rivers, and lands, and to preserve wilderness resource values and related recreational opportunities including but not limited to hiking, canoeing, fishing and sport hunting, within large arctic and subarctic wildlands and on freeflowing rivers; and to maintain opportunities for scientific research and undisturbed ecosystems.

The distribution of current national conservation system units in Alaska are presented in the following tables. "Arctic" as used in the tables includes those units northerly and westerly of the Porcupine and Yukon Rivers as well as those of the deltas of the Yukon and Kuskokwim Rivers and adjacent lands, the Alaska Peninsula and Aleutian Islands. "Subarctic" includes the remaining units in Alaska except for those of which all or the majority of the unit lies south of 60° N latitude generally in the coastal rain forest belt. Units predominantly in the arctic or subarctic zones are included entirely in that zone. Only the approximate areas of federal lands and interest in lands are given in Table 1.

Altogether these conservation system units total about 54.8 million hectares and 36 per cent of the States 151.9 million hectares of lands and inland waters. National Park System units account for about 14 per cent of total State area and the wildlife refuges make up about 20.5 per cent. Conservation system units in arctic Alaska total about 36,952,770 hectares and about 24 per cent of the State's total area. These estimates are based on the federally owned lands within the boundaries.

A few words of description may help relate CSUs to further remarks to be made about management of the CSUs. The national forest wilderness areas are road free. Uses must be compatible. Means of access are limited. Hunting is allowed. Misty Fjords and Admiralty Island National Monuments are largely designated wilderness but an area is excluded from wilderness in each to facilitate development of prior right mineral deposits. Roads will be built to the mine sites.

Eleven of the 16 wildlife refuges in Alaska enclose lands in the most productive low elevation wetlands of the State. Only four units do not have any villages within their external boundaries. The remainder enclose from one village (4 units) to several and the Yukon Delta refuge contains more than 40 villages. Many of the wildlife refuges are subject to considerable subsistence activity by the villagers. Native corporations may own considerable acreage within the refuge boundaries primarily around villages. State lands and submerged lands may also be present. However, the wildlife refuges are predominantly federally owned. Hunting and trapping are permitted.

National parklands in Alaska consist of parks, monuments, preserves, two historical parks and one wild river segment outside the units. Roads of significance penetrate two of the units. One park encloses a native village. Approximately one million hectares of non-federal lands are within the unit boundaries mostly along the perimeter. Sport hunting is prohibited in the parks and monuments. Sport and subsistence hunting and trapping are allowed in the preserves. Subsistence hunting is allowed in seven of the ten parks and monuments. The two historical parks protect lands associated with the Klondike gold rush. Other of the new or expanded parks are known to contain cultural resource values of significance in Alaskan archaeology.

Table I

National Park System

	Arctic	Subarctic	Other
Alagnak Wild River	10,100		
Aniakchak National Monument and Preserve	240,779		
Bering Land Bridge National Preserve	1,085,741		
Cape Krusenstern National Monument	220,759		
Denali National Park and Preserve		2,414,140	
Gates of the Arctic National Park and Preserve	3,323,907		
Glacier Bay National Park and Preserve			1,326,881
Katmai National Park and Preserve	1,608,592		
Kenai Fjords National Park			234,673
Klondike Gold Rush National Historical Park			977
Kobuk Valley National Park	692,390		
Lake Clark National Park and Preserve		1,503,726	
Noatak National Preserve	2,651,927		
Sitka National Historical Park			22
Wrangell-St. Elias National Park and Preserve		4,938,896	
Yukon-Charley Rivers National Preserve		882,102	
Subtotal:	9,834,195	9,738,864	1,562,553

Total: 21,135,612 hectares of Federal lands

About 13,490,129 hectares are designated as wilderness in eight units ranging from 63,828 to 3,796,994 hectares in area.

National Wildlife Refuge System

National Wildlife Refuge	Arctic	Subarctic	Other
Alaska Maritime	1,320,026		117,361
Alaska Peninsula	1,416,431		
Arctic	7,767,246		
Becharof	485,633		
Innoko		1,558,074	
Izembek	129,864		
Kanuti	578,713		
Kenai		797,248	
Kodiak			754,755
Koyukuk	1,436,665		
Nowitna		631,323	
Selawik	870,093		
Tetlin		283,286	
Togiak	1,661,271		
Yukon Delta	7,941,909		
Yukon Flats	3,492,513		
Subtotal:	27,100,364	3,269,931	872,116

Total: 31,242,411 hectares of Federal lands

About 7,558,196 hectares are designated as wilderness within 13 units ranging in size from about 13 to 3,237,556 hectares.

Table I (Cont'd)

National Wild and Scenic River System (Not included in the National Park or Wildlife Refuge Systems)

	Arctic	Subarctic	Other
Beaver Creek Wild River		29,138	
Birch Creek Wild River		26,710	
Delta Wild and Recreational River		14,974	
Gulkana Wild River		36,827	
Forty Mile Wild, Scenic and Recreation River		98,341	
Unalakleet Wild River	18,211		
Subtotal:	18,211	205,990	0

Total: 224,201 hectares of Federal land

National Forest System – National Monuments and Wilderness Areas

	Arctic	Subarctic	Other
Admiralty Island National Monument			372,724
Misty Fjords National Monument			924,727
12 Wilderness Areas			941,278
Subtotal:	0	0	2,238,729

Total: 2,238,366 hectares of Federal lands

Approximately 364,225 hectares of Admiralty Island National Monument and 864,427 hectares of Misty Fjords National Monument are designated as wilderness.

The sequence of establishment described is not complete without backtracking several years. Other factors helped form the present situation. In 1964, after several years of debate, Congress passed "An Act Establishing a Wilderness Preservation System" or the "Wilderness Act" as commonly referred to. Wilderness designation is considered to be the highest level of protection afforded any land in the United States, even in a park, for conservation purposes. In 1970, 1975 and 1976 the first wilderness areas in Alaska were designated by the Congress following the prerequisite studies and recommendations required by the Wilderness Act. These involved several relatively small island groups that are national wildlife refuges.

Also during the late 1960s and early 1970s the National Park Service, Fish and Wildlife Service and the Forest Service were conducting wilderness studies of the roadless areas under their administrations as required by law. Recommendations resulting from these studies were considered during debate and passage of ANILCA relative to wilderness areas designated by that act.

Just prior to the passage of ANCSA during 1970-71, the Park Service prepared a proposed list of national parks in Alaska. Though the list included areas that had been identified over the years, or even decades in some cases, the list went further. The list was derived from an attempt to provide in a system of parks comprehensive representation of the features of the natural regions of Alaska and of Alaska's historic themes. While not totally achieved in ANILCA it did provide the basis for most of the parks established and helped focus attention on representation throughout much of the State. It was simply not feasible or practical to push for units of the park system in some areas where other agencies, or the State or Native selections competed for what land was available. Many of the areas are protected in other conservation systems though.

At the same time the US Fish and Wildlife Service was focussing on the wetlands of Alaska important to migratory birds, especially waterfowl.

Implementation of ANILCA is another matter. Immediately after passage of ANILCA, regional offices were established in Alaska for the National Park Service and Fish and Wildlife Service because of the additional responsibilities of each service. While NPS and FWS in Alaska each had more assigned acreage than in all of the park and refuge units in the lower 48 states, funding and manpower to meet the new responsibilities and demands have not become immediately available. The first years of implementation have coincided with a major administrative thrust in the United States to improve the economic health of the nation. As part of the plan, considerable effort has been made to control and reduce federal spending. Funding has increased in Alaska but only slowly and CSU staffs, while they have grown, are not large nor as complete as unit managers think is necessary for proper management. Regional support staffs have been limited as well. In most cases single parkland units have a staff solely for that unit. In one situation a field office manages three units and another manages two units.

Funding for the National Park Service, Alaska Region, has increased from $16,940,000 for fiscal year (FY) 1981 to $23,777,000 for FY 1985. Employment has increased for the same period for the Alaska Region from a total of permanent and seasonal positions equivalent to 126 full time positions to 267 full time equivalent (FTE). Funding for all US Fish and Wildlife Service activities in Alaska has increased from $14,800,000 for FY 1981 to $54,400,000 for FY 1985. Most of this increase is involved in refuge management. Permanent full time employees numbered 261 in FY 1981, FTE's have increased from 350 in FY 1982 to 367 in FY 1985.

During this time visitation in parks has increased from 625,399 visits to all parklands in 1982 to 789,942 visits in 1984. Visits to all parklands in 1985 through August totaled 711,612.

Relative to employment, ANILCA recognized a need for jobs in rural Alaska and the value for land managing agencies to employ persons who have lived or worked in or near a CSU and have special knowledge or expertise concerning the natural or cultural resources of the unit. Such persons may be employed and are exempted from minimum requirements of formal training or experience, from other employment preferences, and from numerical limitations. This program has provided some benefits. One of its drawbacks is that most of the jobs available do not pay sufficiently to compete with seasonal jobs available in industry or government firefighting jobs.

Establishing new field offices where necessary was one of the first orders of business. In nearly all cases they are located at the nearest large community where office space and housing could be acquired. These communities provide some amenities for park or refuge employee families and also tend to be at the hub of local activity in and about the parklands and refuges. Few permanent facilities will likely be placed in the new parks. A handful of seasonal tent facilities have been established in the parks and in a few cases existing structures are occupied by seasonal rangers. Funding is becoming available to obtain necessary facilities and there is an effort to develop or acquire facilities to be jointly used by the NPS, FWS and the Bureau of Land Management at several field locations.

Several management issues exist in the CSUs in Alaska, perhaps more so in the parklands than in other CSUs. Some of these were anticipated and ANILCA provides direction and requirements implemented by regulations. Perhaps most significant are the conservation and management plans required to be prepared and transmitted to the Congress by December 1985. The general management plan (GMP), as the NPS calls it, identifies management practices for the next five to ten years to carry out the policies of ANILCA and accomplish the purposes for which the CSU was established. Similarly, comprehensive conservation plans are to be developed for the wildlife refuges over a seven year period. ANILCA also directed that the agencies review within five years all lands not designated as wilderness within the National Park and Wildlife Refuge Systems and report on their suitability or nonsuitability for preservation as wilderness. The President is to advise the Congress of his specific wilderness recommendations by December 1987.

Plan development and preparation requires public participation through public meetings and the opportunity to submit comments on the plans. Reviews by officials of the State, Native corporations, concerned local, State, and national organizations and interested individuals, and the Alaska Land Use Council (ALUC) are required.

The ALUC is a body established by ANILCA composed of federal, state and native representation, primarily the heads of the land management agencies in Alaska. The principal function of the council is to review, make studies and analyses and make recommendations to appropriate officials with respect to management plans, proposed regulations, interagency and state-federal coordination, orderly economic development, use of federal and state lands and other matters to facilitate implementation of ANILCA.

Management of CSUs to date has basically been to manage the units within the law but without actions that could compromise long-term options. Alternative management options within the GMPs have not varied greatly from the present situation. Park management has generally wanted to increase its capability to know more about park resources, protect those resources, and provide some assistance and protection to park visitors. Public comments from environmental organizations have urged that the maximum amount of land not already designated as wilderness be safeguarded and recommended for wilderness designation. Any developments for visitor services are encouraged to be outside the CSUs on private lands. Roads are not desired. Nearby residents do not want their patterns of use limited or interfered with. Those owning lands within the parklands want to be left alone and do not want their property acquired by the government. Based on plans approved to date and what will likely be presented as the final plan in the remainder, the GMPs are setting forth a very conservative approach to the management of the parklands emphasizing perpetuation of the natural qualities. This is not without some controversy. Visitor services will be provided by those already in business on their private lands within or adjacent to the parklands. ANILCA provides that to the extent practicable and desirable, visitor services and facilities should be located on native lands in the vicinity of the unit. Preference is to be given to native corporations to provide public services where any contract is called for. Persons who before 1 January 1979 were engaged in adequately providing visitor services were allowed to continue if the service was consistent with the purpose of the unit.

While general transportation systems, especially new roads are not proposed in the GMPs, the subject of access is worthy of mention. Alaska has a relatively small road system compared to any of the other 49 states. Few of the roads penetrate into the CSUs. Because of remoteness, lack of roads, and tradition, Title XI of ANILCA provides for access to all CSUs by the use of snowmachines, motorboats, airplanes and nonmotorized surface transportation methods for allowed traditional activities. Such uses may be subject to reasonable regulations to protect natural values but may not be prohibited until after notice, a hearing, and a finding that a use is detrimental to the resource values of a unit. Landholders within CSUs shall be given such rights as may be necessary to assure adequate and feasible access for economic and other purposes. Additionally, the Secretary of the Interior shall permit on the public lands for subsistence purposes, the use of snowmobiles, motorboats, and other means of surface transportation traditionally employed for such purposes.

Also recognizing the largely undeveloped transportation system in Alaska and the extent of the CSUs being established, the Congress provided for a uniform means of application, processing and approval or disapproval of transportation and utility systems proposed to cross one or more conservation system units. An expedited congressional procedure is also established when the Congress must approve a road or other facility because an agency or agencies lack authority to approve the facility crossing certain lands.

Other major issues that developed during the deliberation of ANILCA revolve around hunting. Sport hunters, recognizing that some proposed park areas had been hunted for decades, made a very concerted effort to either exclude some lands from parks or to provide for sport hunting in Alaska parks. Wanting to avoid a precedent that could adversely affect parks and monument designations in the lower 48 states where hunting is not allowed, and desiring to protect entire landscapes and "ecosystems" to the extent possible, a compromise was made. National preserves were established to be managed in Alaska as a park in all other respects but allowing sport hunting and trapping.

Alaska natives and other rural residents also had great concerns about their dependency on wildlife and their needs to continue to be able to harvest wildlife, berries, roots, greens, trees, etc., from the public lands to preserve their lifeways. In spite of a generally healthy economy in Alaska and jobs in the cities and at resource development sites, there are few jobs available in the smaller villages and many people rely on the land, at least in part, for sustenance. As a result ANILCA provided that subsistence uses by local residents would be permitted in the preserves and most of the parks and monuments excluding only the older parks and one new unit where no subsistence hunting had taken place for many years. To provide local assistance and input into park and monument subsistence programs, ANILCA directs that Park and Monument Subsistence Resource Commissions be established for each park or monument open to subsistence. The commissions are presently devising and will recommend to the Secretary and the Governor programs for subsistence hunting in each parkland. ANILCA points out that hunting should not threaten the conservation of natural and healthy populations of fish and wildlife in the parks and monuments, nor should hunting be inconsistent with the conservation of healthy populations in the other CSUs.

Except for the national forest wilderness areas, most of the parklands and wildlife refuges enclose within the exterior boundaries some State, native corporation and other privately owned lands. The federal reservations were subject to valid existing rights. Non-federal lands in the National Park System units are expected to total about one million hectares. Non-federal ownership within the wildlife refuges is greater. Congress, in approving preferred CSU boundaries to the extent it did, provided for two concerns. One, the non-federal lands within the boundaries are not subject to regulations applicable only to the CSUs and the agencies exercise only proprietary jurisdiction over the federal lands in the unit. Also, the state lands and the lands owned by Native corporations cannot be acquired by the United States without the consent of the owner. This was to protect the rights and lands granted under the Statehood Act and the ANCSA. Two, the managing agency can endeavour to protect the non-federal lands and their resources within the CSU, in order to further the purposes of the CSU. ANILCA provides broad acquisition and exchange authority to acquire lands and interests in lands as necessary and if possible. Land exchanges are encouraged by the law. In fact, it was obvious that the imperfect formulas for allocating lands to the natives and to the State, and these overlapping with federal concerns, would not form optimum management units or necessarily provide recipients the resources they desired. Congress envisioned that land exchanges would be desired and should be encouraged and that benefits could be derived by all parties. Work remains to be done to facilitate land exchanges. A few exchanges have been successful. One was not. Others are in the process of negotiation or formulation.

Congress established another provision and it is hoped it will benefit both the native land owners and the United States. Entitled the Alaska Land Bank, the provision establishes incentives for not developing land and placing lands in the land bank. While in the land bank the lands would serve as wildlife habitat and maintain their natural appearance and values. Purposes of the CSUs would be furthered by this form of land protection. While the lands continue to provide subsistence resources to the owner, the native owners have immunity from adverse possession, real property taxes by the US, the State or any political subdivision, and judgement in any action at law or equity to recover sums owed or penalties incurred by the owners. Further, fire control is provided and such other technical or other assistance the Secretary agrees to. Lands to be developed are withdrawn from the land bank.

Each park must prepare a land protection plan involving public participation which sets forth the approach the National Park Service will use to protect non-federal lands and adjacent park resources. Based on resource values and public use or access needs, the plan identifies the minimum interest or measure required by the United States to assure protection. A land protection plan may find fee acquisition by purchase appropriate in some cases. A conservation or access easement may be sufficient. A cooperative agreement such as the Alaska Land Bank can provide protection as long as the goals of the owner are in concert with those of the agency. Land exchanges are generally the preferred method of acquisition in order to limit expenditures. Similar actions take place in the wildlife refuges.

Alaska strongly protested seaward boundaries from coastal CSUs with concern that the State would lose the ability to develop its coastal submerged lands. ANILCA precludes seaward boundaries beyond the line of mean high tide unless the State has concurred in such a boundary extension. In several park and wildlife refuges there is concern that development of the State's coastal submerged lands or the beds of wild rivers or other navigable waterways would be detrimental to wildlife, scenic, wilderness, recreational or other values. Efforts to work with the State to protect these areas through regulated closure and to support "marine sanctuaries" in some waters is an ongoing task.

Another management issue that will require more attention in the future and is a somewhat emotional issue is that of controlling the number and distribution of park visitors. This might be done in order to provide quality wilderness experiences or it may be deemed necessary to protect park resources. For several years now, Denali National Park has limited the number of overnight parties into identified geographical units. This action has served both purposes. The park has also precluded hikers from areas of wolf dens during critical times to prevent disturbance while the young are raised.

Travel over the Denali park road is also restricted. When the shortest highway between Anchorage and Fairbanks was completed and opened in 1972, the park initiated a shuttle bus system to lessen the number of vehicles on the park road. Observations already indicated that park animals moved away from the road during the heaviest traffic. Visitors leave their cars near the entrance to the park and ride the buses which have been free until recently. Subsequent studies supported the traffic limitations if wildlife viewing was to remain a major value to park visitors. During the summer of 1985 a further restriction had been implemented limiting the number of buses on a daily basis in order to protect park resources.

Vegetative cover in the arctic and subarctic may be easily disturbed or destroyed through improper use or too much use. Short growing seasons, harsh climate, and permafrost conditions all contribute to the sensitivity of plants and soils. Areas of relatively high visitor use are showing signs of overuse not only to the ground cover but in the collection of firewood where trees exist.

In developing the GMP for the Gates of the Arctic National Park and Preserve, the planners have proposed limiting the size of backcountry groups to six persons so as to limit the impacts where groups camp. The management scheme also plans to disperse visitors.

Since the parklands are spacious, the key to preventing overuse or overcrowding may be the means by which we encourage visitors to go to lesser used parts of a park.

Mining of valid existing rights is occurring or being planned for in some of the Alaska CSUs. While the CSUs were withdrawn from location and entry under the US mining laws from the mineral leasing laws (mineral leasing may occur in refuges if compatible), there were numerous pre-existing mining claims. Over 4000 mining claims existed in the parklands. Mineral contests and other deficiencies have voided over half of the claims. Forty-one mining operations, all but two of them placer operations, were underway during 1985 in parklands. Principal issues regarding these operations are whether significant park resources are being lost or adversely affected, failure of most miners to attain state water quality standards in their discharge waters, and reclamation of claims following the completion of mining.

There have been and will continue to be international cooperative efforts. The National Park Service (NPS) and Parks Canada cooperate in management efforts regarding the contiguous Wrangell-St. Elias National Park and Preserve and the Kluane National Park of Canada. More related to the Arctic will be cooperative efforts regarding the Arctic National Wildlife Refuge and the newly established North Yukon National Park. Relative to this international area, efforts continue in the United States and Canada towards a convention concerned with the protection of the Porcupine caribou herd – an international resource.

One world heritage site has been designated in Alaska to date. Parks Canada and the US National Park Service jointly recommended the contiguous Wrangell-St. Elias National Park and Preserve of Alaska and the Kluane National Park of Canada. No other conservation system units in Alaska have yet been approved as world heritage sites but further nominations may be made.

The former Mount McKinley National Park within Denali National Park and Preserve, the Noatak Basin within the Noatak National Preserve and Gates of the Arctic National Park and the Aleutian Islands unit of the Alaska Maritime National Wildlife Refuge have been designated as biosphere reserves as part of the Man and the Biosphere program. Admiralty Island and Glacier Bay have been proposed and technically approved as biosphere reserves and final approval is expected shortly.

Other management concerns and issues exist but are not presented here. This presentation has been an introduction and a narrow perspective of the establishment and management of conservation system units in Alaska. It has dealt primarily with the land base and major actions in Alaska to set aside federal reservations to protect Alaska's natural and cultural resources. It has not dealt with state or federal regulatory actions to conserve wildlife resource values in Alaska including regulation of harvest levels of salmon, migratory birds, caribou, brown bear, or many other animals that give life to the land base. Without returning salmon, caribou or migratory birds each year, many of the federal reservations would lose many of the values for which they have been set aside. Food supplies and chains would be greatly altered. Maintaining in perpetuity the integrity and grandness of many of the splendid areas set aside depends on controlling several factors, some of which extend well beyond Alaska's borders.

It is too soon to tell how well we are managing the conservation system units in arctic and other areas of Alaska. We have learned that we need to know a great deal more about the resources if we are to manage the CSUs in an unimpaired state for the benefit of present and future generations.

References and Notes

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Note:

- No attempt has been made to identify in this bibliography the numerous volumes of material recording the legislative record and numerous studies related to establishment and management of conservation system units in Alaska.

- The General Management Plans for the parklands are expected to be completed by the end of 1985. Comprehensive Conservation Plans for the wildlife refuges are expected to be completed by the end of 1987. Many pertinent documents are identified in these plans.

- Areal figures stated herein are approximate and subject to change. Federal land area cited is subject to further conveyances of valid native, state and other land selections and will be further affected by determination of navigable waters and a recent policy change regarding the conveyance of certain non-navigable submerged lands.

National Overview for Canada On National Parks and Protected Areas in the Arctic

Tom J. Kovacs

Introduction

To a degree, the state of a nation's natural environment is an expression of its conservation ethic. Conservation is practised in two basic forms. Setting up legally defined areas to protect certain features or values is one possibility. Applying wise use of the land in general to achieve man's best interest on a sustained basis is another.

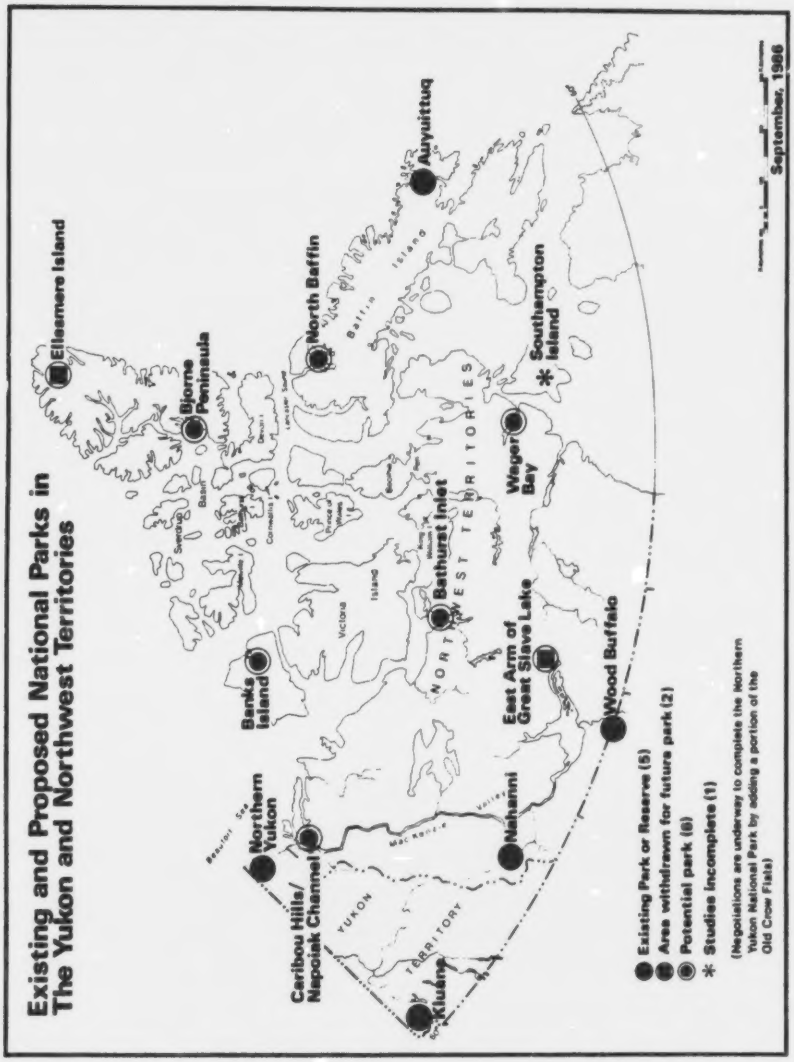
In northern Canada most of the conservation effort has been directed at the establishment of protected areas. Conservation, in the sense of wise land use, is a more recent concern. Both approaches are important to cover the wide spectrum of conservation requirements ranging from the preservation of the unique and endangered to ensuring long-term resource utilization. This paper is a national overview for Canada on national parks and other protected areas in the Arctic. It does not focus on conservation in general, nor does it address the conservation of historic and cultural resources of the territories.

The Land and the People

This paper deals with the vast northern expanse of 4 million square kilometres known as the Yukon and Northwest Territories. For ease of identification these two political entities have been chosen to describe the area of interest, recognizing that they include sub-arctic as well as arctic lands.

Lying generally north of 60° the two territories comprise nearly 40 per cent of the area of Canada and extend nearly 3000 kilometres to the North Pole. From east to west the territories cover almost the same distance (Figure 1).

Of the two, the Northwest Territories is by far the larger. At nearly 3.4 million square kilometres it contains 34 per cent of Canada's land mass. With 482,000 square kilometres, the Yukon represents 5 per cent of Canada. Both territories are geographically diverse and scenic. Both



Existing and Proposed National Parks in The Yukon and Northwest Territories

- ● Existing Park or Reserve (5)
- ● Area withdrawn for future park (2)
- ◉ Potential park (6)
- * Studies incomplete (1)

(Negotiations are underway to complete the Northern Yukon National Park by adding a portion of the Old Crow Flats) contain internationally and nationally significant natural systems existing in a relatively undisturbed state. As such they are a storehouse of ecological diversity retaining wildlife of vital interest to the people of the north.

The territories are lands of superlative natural features. Yukon, renowned for its scenic beauty, mountain ranges, plateaus and coastal plains, contains Canada's highest peaks in the St. Elias Range. Butting up against Alaska on the west, Yukon is also the northernmost extension of many faunal and floral species. East of Yukon lie the immense plains of the Northwest Territories and the vast Canadian Shield. The eastern Arctic is dominated by the rugged mountains of Baffin and Ellesmere islands, the latter containing Canada's northernmost lands, tallest mountains in eastern North America, and Lake Hazen, the largest lake in the world north of the Arctic Circle. The innumerable rivers and lakes of the Canadian Shield and the 173,000 kilometres of coastline and land-fast ice are of special importance to the people of the Northwest Territories.

From the point of view of conservation, the most important environmental feature of the territories is their harsh climate. In the Northwest Territories the arctic can be described as a treeless tundra lying north of the 10° C isotherm for July. South of the tree line lies the subarctic characterized by boreal forests. In Yukon, subarctic regions are intergraded with subalpine, depending on elevations. Significant components of the harsh climate are vast systems of polar glaciers, icefields, continuous and discontinuous permafrost. These arctic and subarctic features permit but a generally low rate of biological productivity. Compared to more temperate zones, arctic environments are notably sparse in floral species and are characterized by few migratory species of bird and wildlife.

Areas of high productivity are few and localized, making them potentially susceptible to environmental damage. Their protection is critical. The word "fragility" is frequently used to describe the northern environment. It has been noted that structurally simple northern ecosystems have survived due to their large geographic scale (Dunbar, 1973). The vulnerability of tundra and boreal ecosystems makes conservation, or the wise use of land, imperative in the face of increasing human activity in the north.

Man has lived in these northern lands for some 30,000 years. Prior to European contact, the native people were wholly dependent for their livelihood on nature and wildlife. The Dene and Inuit, at least until the introduction of the fur economy in the seventeenth century, were self-sufficient and lived in harmony with their natural surroundings. Demand for fur in Europe led to a gradual depletion of wildlife and by the beginning of the twentieth century many fur species faced extinction. Their declining numbers brought hardship to native people who had gradually become dependent on items of trade.

The depletion of wildlife due to overhunting gave rise to the first attempts at northern conservation by the federal government. This process was hastened by the whaling industry both in the western and eastern arctic, and by the beginning of mining activity in Yukon during the latter part of the nineteenth century. Later some of the early industrial developments in the Northwest Territories related to minerals, oil and gas gave added impetus to conservation.

Since the beginning of World War II industrial developments have increased at an accelerated rate. The unprecedented in-roads made into untouched natural lands compelled the federal government to consider policies of balance between development and conservation.

Today, the combined population of the territories is 70,000. Out of the total 46,000 people in the Northwest Territories, 60 per cent are native. In Yukon, 33 per cent of the total population of 24,000 is of native origin. The population density for Yukon is 20 square kilometres per person. That for the Northwest Territories is 73 square kilometres per person. Overall the population is young, with half the native people less than 15 years of age (Nelson, 1982). Although increasingly sedentary, the native population is largely dependent on the land for nutritional, cultural and spiritual reasons. For them, conservation, i.e. the protection of resources to permit sustained use, is central to their being; it is part of their value system and entire social and economic fabric (Usher, 1982).

Northern populations are the fastest growing in Canada, at a time when the productive capacity of natural systems is being reduced through resource development. The combined effect points to the need for greater conservation.

The territories are going through a period of fundamental change due to political devolution, native claims settlement and transfer of power from the federal government to territorial governments, a process that may culminate in provincehood for the territories at some point in the future. The division of the Northwest Territories into eastern (Nunavut) and western portions is a distinct possibility. One of the native claims, the Western Arctic Inuvialuit, was settled in 1984. Three other major claims, those of the Dene/Metis, the Tungavik Federation of Nunavut and the Council for Yukon Indians, are under negotiation and will have a profound effect on land ownership and management in both territories.

History of National Parks and Protected Areas

Early Preserves

The roots of institutionalized conservation by the federal government in the Canadian north go back to the latter part of the last century when the

Unorganized Territories Game Preservation Act was passed in 1894 to protect game for the benefit of native hunters. Concern for game protection arose from the destruction of wildlife by commercial hunters, trappers, whalers, explorers and the increasing number of whites brought north by the lure of gold and minerals. Early legislators were aware of the dependence of native people on game and a number of amendments were made to the Act between 1894 and 1905 (Hunt, 1976). This Act was replaced in 1906 by the *Northwest Game Act*; however, this did not affect the rights of native people.

In 1917 the Act was completely revised and in the same year the *Migratory Birds Convention Act* was passed. As a result of regulations promulgated in 1918 pursuant to the *Northwest Game Act*, Victoria Island and then in 1920 Banks Island were made native hunting reserves. However, these measures were not deemed adequate in the light of rapidly declining wildlife and in 1923 native hunting preserves were expanded to cover areas south of Banks and Victoria Islands and around the town of Yellowknife. Peel, Backs and Slave Rivers were also set aside for exclusive native hunting.

In 1926 the reserve system was significantly expanded with the establishment of the Arctic Islands Preserve. Official correspondence at the time indicates that in addition to protecting the interests of native people, the Arctic Island Preserve was used as a means of establishing Canadian sovereignty in the Arctic.

The next two decades following 1926 saw the gradual expansion of areas set aside for the exclusive use of native people until the preserve system was given immense proportions. By 1938, it consisted of 1.35 million square kilometres or well over one-third of the Northwest Territories. Further additions were made until 1948. Then, having attained its maximum extent, the system was gradually reduced. Today only a few of the smaller reserves are in existence. In the following year the territorial government passed the *Game Ordinance* of 1949 to replace the *Northwest Game Act* which the federal government repealed and in 1966 the Arctic Islands Reserve was abolished bringing to an end a remarkable period of conservation aimed at the welfare of the native people. The abolition of the preserves could have given rise again to a Norwegian claim to the Arctic Islands, which was withdrawn when the Canadian government promised to set aside the Arctic Islands Preserve in 1926 for the benefit of the native inhabitants. Subsequent amendments in the Ordinance reduced the preserve system.

In addition to the above preserves, several game sanctuaries were also established where hunting was prohibited altogether. To protect the musk-ox a sanctuary was established on the Thelon River in 1927. This was followed by the setting aside of a reindeer grazing reserve in the Tuktoyaktuk Peninsula in 1933, the Twin Island Game Sanctuary in 1939, and the Mackenzie Delta Beaver Sanctuary in 1940 (Hunt, 1976).

National Parks

Although in existence in Canada since 1885, the year Banff was established, national parks had no part in northern conservation until 1922. In that year, however, Wood Buffalo National Park was established straddling the Alberta-Northwest Territories border, an act described as the most far-sighted and important conservation measure ever taken by the Government of Canada. The purpose of the national park was to save the wood bison from extinction.

In 1922 an area of 27,510 square kilometres was set aside by Order-in-Council to create Wood Buffalo National Park. In 1925 the park was expanded to the south to its present size of 44,807 square kilometres, (9,454 of which lie in the Northwest Territories) making it the largest national park in the world. This distinction was surpassed in 1982 when the Danish government established a 700,000 square kilometre national park in northern Greenland.

A highlight in the park's history occurred in 1954 when the nesting grounds of the whooping crane were discovered in the Northwest Territories portion of the park (Lothian, 1981). In 1983 the park was placed on the World Heritage List in recognition of its superlative natural values.

It was not until 1942 that the next tentative step in the development of northern national parks was taken. During that year, at the recommendation of army officers working on the Alaska Highway, the Governor in Council created Kluane National Park Reserve. The next year, under ordinances of the Yukon Territory, the area was also designated as a Game Sanctuary until such time as the schedule of the *National Parks Act* could be amended. Consisting of 26,236 square kilometres, the Reserve was set up to protect game from the influx of people travelling the newly completed Alaska Highway. Subsequent Orders-in-Council altered the Reserve's boundary and allowed mineral prospecting, claim staking and the granting of mineral rights. The presence of mineral interests in the Reserve prolonged the establishment of Kluane National Park until 1972, an event preceded by much controversy and requiring compromise on both the conservation and the mineral side.

In 1974, the *National Park Act* was amended thereby formally establishing Kluane as a National Park Reserve.

Reserve status in this sense, however, referred to an interim measure in the process of park establishment with regard to the rights of native people. Although managed under the *National Parks Act*, Kluane and its sister parks of Nahanni and Auyuittuq, will not achieve full status until the outstanding native claims in the north are settled.

While the claim of the Council for Yukon Indians remains unsettled, an unratified Agreement in Principle reached in 1984 refers to no significant loss of park lands due to native land selection. It appears that the Reserve will remain essentially intact to reach full national park status.

In 1979 the park was designated as a World Heritage Site along with Wrangell-St. Elias National Park on the Alaska side of the border, giving recognition to its outstanding natural values and importance in the protection of northern landscapes and wildlife.

The two other national park reserves, Nahanni and Auyuittuq, were established in 1972. Nahanni is also a product of conflict and compromise. The spectacular 4,765 square kilometres area of the park, centered on the fabled Nahanni River, was of interest to both mineral concerns and conservationists. Virginia Falls, the last major unharnessed falls in Canada, was coveted for its hydroelectric potential. Again, the federal Cabinet decided in favour of conservation values; however, as in the case of Kluane, certain lands were excluded because of mineral considerations. The boundaries set in 1972 did not prove to be fully satisfactory. Their inadequacy was highlighted during the park management planning process. In line with the 1979 Parks Canada Policy, areas for possible inclusion will be examined by the Geologic Survey of Canada for their mineral and energy potential as part of the consideration being given to enlarging the park. Nahanni was the first Canadian park placed on the World Heritage Site list, having attained that distinction in 1978.

Auyuittuq is located on Baffin Island. The name of the park is derived from the Inuit word meaning "the land that never melts." This magnificent representation of the Northern Davis Natural Region with icefields, glaciers and the scenic Pangnirtung Pass is 21,471 square kilometres in size, the third largest national park in the system.

The area of the park is about 1000 square kilometres less than what was proposed in 1971 because a coastal area and a portion of the Baffin Plateau were recognized as important Inuit hunting grounds when the park was established.

As large as these three northern park reserves appear to be, it is evident that very large areas are needed to protect northern ecology. In the case of Kluane, wolf and caribou ranges were left outside the boundaries. Important Dall sheep habitat, areas of exceptional vegetation diversity and karst topography were not included in the Nahanni Park Reserve. The requirement to protect the Penny Icecap and the system of glaciers meant that Auyuittuq had to be large.

A different sort of concern surrounded the East Arm of Great Slave Lake national park proposal. This was one of the first new northern park areas where action was taken toward park establishment by means of a land withdrawal in 1970 under the *Territorial Lands Act.* The park proposal quickly ran into local opposition and a five year moratorium was put into effect to allow the Snowdrift Indian band longer time to consider the idea of a national park. The moratorium deadline was passed without progress and the proposal has been on hold ever since. During the last few years mineral interests have lobbied the federal government to resolve the East Arm situation either by proceeding to national park status or by releasing the withdrawn lands for exploration and development. The local people, however, preferred to maintain the withdrawal indefinitely. Recently, the Dene Nation indicated a willingness to examine local support for the park and to consider it within their land claim settlement. The future of the East Arm withdrawal is expected to be decided in 1986.

During the 1970s much emphasis was placed by Parks Canada on the systematic selection and field identification of potential national parks. The completion of the national parks system, based on representing 39 terrestrial and three marine natural regions, became a federal objective. (Recent studies have defined 29 marine natural regions for Canada).

Reflecting changing realities in the north, in 1978 a two-year public consultation program involving six new northern initiatives was announced. These were Northern Yukon, Banks Island, Ellesmere Island, Wager Bay, Bathurst Inlet and the pingos of Tuktoyaktuk. There was general support for northern national parks; however, each of the six initiatives was found to be in a unique situation and required to be brought along according to the special circumstances surrounding them (Parks Canada, 1980). The consultative approach has indicated that the time for unilateral action by the federal government has passed. There were no public consultations preceding the establishment of Kluane, Nahanni, and Auyuittuq.

In the following years good progress was made in discussing the Ellesmere Island National Park proposal with the Government of the Northwest Territories, local people and native organizations. As a result, in 1982, an area of 39,500 square kilometres was set aside by Order-in-Council. Following some delays agreement has been reached with the territorial government on the terms and conditions for the park, opening the way for establishing Ellesmere Island National Park Reserve in the Centennial Year of Canada's National Parks.

Northern Yukon was placed under interim protection by an Order-in-Council in 1978 when some 38,700 square kilometres were set aside as the initial step toward creating Canada's first national wilderness park. However, Northern Yukon soon became the scene of intense controversy involving native organizations, federal government departments with conflicting mandates, the Yukon Government and industry. During the early years of this decade, it was the most disputed conservation issue in Canada. It was finally resolved by the settlement of the Western Arctic Inuvialuit Claim. As a direct consequence of the Committee for the Original Peoples' Entitlement agreement, the North Slope portion of the proposed national park, comprising 10,170 square kilometres, was established in 1984. In the remainder of the North Slope "a conservation regime whose dominant purpose is the conservation of wildlife habitat and traditional native use" was created. The Inuvialuit will continue wildlife harvesting in the national park, provide advice on park planning and management, and recommend a management plan. These terms may set precedence for future national park establishment in the north and the involvement of native people in park planning and management. The Old Crow portion (4724 square kilometres) of the proposed park is tied in with the Council for the Yukon Indians native claim and is still protected under the 1978 land withdrawal. As in previous cases, the establishment of Northern Yukon National park involved making compromises. For example, the park is considerably smaller on the east than what was envisaged by the Department of the Environment. On the other hand, Mount Sedgwick, an area of mineral interest, was retained within the new national park.

Except for Wood Buffalo, national parks were absent from the territories until 1972 when three national park reserves were established without public consultation on the strength of federal authority. These were to be the only park reserves established in the north by unilateral federal action. (As noted, Northern Yukon was a product of the land claims process). The seemingly slow process of the new northern park program was due in part to policies and procedures which did not reflect rapidly enough the changing northern circumstances. Where progress was made, as in the case of Ellesmere Island and more recently at East Arm, it was due to the exercise of institutional flexibility, new consultative approaches and policies more accommodating to territorial and native concerns.

Other reasons behind the slow progress had to do with the tenuous relationship between the federal and territorial governments, competition among resources and conservation sectors for the same land, failure to reach accord between native people and conservationists, ambiguity in mandates, delays in native claim negotiations and the absence of comprehensive plans and a coordinated approach to northern conservation. As well, the popular wave of environmental concern of the 1960s was overtaken by the so called energy crises that preoccupied public attention from 1974 onwards. During these years the public mood and political agenda changed from environmental concerns to energy supply.

Migratory Bird Sanctuaries

The first waterfowl refuge in North America was established in 1887 at Lost Mountain Lake which was then part of the Northwest Territories. Following the passing of the *Migratory Bird Convention Act* in 1917, called "the most important and far-reaching measure ever taken in the history of bird protection ....", a network of migratory bird sanctuaries was developed throughout southern Canada. It was not until 1957, however, that the first two sanctuaries in the territories were established. The Dewey Soper Bird Sanctuary and the Cape Dorset Bird Sanctuary, both in southern Baffin Island, were created to protect the breeding grounds of lesser snow geese and eider ducks, respectively. At 8159 square kilometres the former is the larger by far and has a population of 455,000 birds or 33 per cent of the total Canadian lesser snow goose population (Environment Canada, 1985).

The establishment of bird sanctuaries was preceded by scientific work carried out in the territories since 1928 on population and habitat requirements of migrating birds, on threatened and endangered species and on mammals of international concern. Between 1928 and 1950 this work was accomplished by Wildlife Division scientists of the National Parks Branch. In 1950 the Canadian Wildlife Service was officially established and named as the federal agency responsible for the administration of the *Migratory Birds Convention Act*.

The broad based work of the Canadian Wildlife Service has led to the establishment of 13 migratory bird sanctuaries in the Northwest Territories since 1957, although none have been declared in Yukon.

In 1973 the *Canada Wildlife Act* was passed and subsequently a number of national wildlife areas was established in the provinces. Although national wildlife areas have been proposed for the north, most notably one for northern Yukon, only one has been established to date. The Polar Bear Pass National Wildlife Area on Bathurst Island is the first in the territories. It has been transferred to Environment Canada to be managed jointly with the Government of the Northwest Territories under the *Canada Wildlife Act*. This represents the first attempt by the Canadian Wildlife Service to reach on agreement with the territorial government on establishing and sharing the management of a national wildlife area. Prior attempts to establish national wildlife areas have been resisted by territorial governments which perceive them to be an intrusion into their responsibilities. In effect, the federal role related to "wildlife" has been confined to responsibilities for migratory birds, fish and marine life.

Territorial Park Systems

Territorial park systems have a recent history. Their development has been thwarted by the lack of a necessary land base. The Department of Indian Affairs and Northern Development controls 99 per cent of all lands in the territories.

In the 1970s park ordinances were passed by both territorial councils for the establishment of a system of territorial parks. In the Northwest Territories the *Territorial Parks Ordinance* was enacted in 1974 with the intent of creating different types of parks. In 1974 the system of parks consisted of 26 sites, all either wayside or community parks comprising 6 square kilometres. By 1977 the number of sites had increased to 36 sites and their size totalled 29 square kilometres. Over the last few years, the territorial government has continued to add new parks to the system and in 1985, 37 sites contain 740 square kilometres. The number of campsites provided is 650.

There are four sanctuaries under the *Wildlife Ordinance* in the Northwest Territories: Thelon (55,167 square kilometres), Twin Islands (143 square kilometres), Bowman Bay (1075 square kilometres) and Mackenzie Bison (36,260 square kilometres). The territorial government also maintains four preserves (Peel River, N.W. Mitchener, James Bay and Reindeer Grazing preserves) which total more than 40,000 square kilometres.

Objectives for the future of the territorial parks are: to meet outdoor recreational needs and to assist local residents in park-related training, employment and business opportunities; to support traditional skills and pursuits in the economy of the Northwest Territories. The territorial government is working on the development of a system of parks which responds directly to the territories unique social, political and economic environment (Vaughan, 1984).

The *Yukon Parks Ordinance* was passed in 1979. It identified six types of parks for the future Yukon park system. Their purpose is "to protect unique natural and historic features and to provide for comprehensive outdoor recreational opportunities." Wilderness preserves and nature preserves are to be created to protect natural features in their natural state. The other park types are for various types of outdoor recreation.

The Yukon territorial parks are called reserves since lands have not yet been transferred to the Yukon Government by the Department of Indian Affairs and Northern Development. There are 47 campgrounds containing 1003 sites. The total area of the reserves is 110 square kilometres. In 1984 the Western Inuvialuit Agreement provided for the establishment of Herschel Island as a territorial park (MacCrae, 1985).

Under the *Game Ordinance*, there are two game sanctuaries (McArthur and Kluane) and two preserves (Peel River and Fishing Branch River) in the Yukon covering a total of 11,267 square kilometres. Native people may hunt within a game preserve; however, no person may hunt within the boundaries of a game sanctuary (Redpath, 1979).

The Yukon Government has identified 11 candidate territorial parks and announced that a park policy and a system plan are currently being developed under the *Territorial Parks Act*.

Although in the planning stages since the early 1970s, the territorial park systems have been slow to develop due to federal reluctance to turn over the necessary lands to territorial administration and due to the fact that the development of institutions, policies and plans require considerable time and funds.

International Programs

Another type of conservation initiative affecting the territories is the International Biological Program which Canada supports along with 57 other nations. Initiated in 1964 the purpose of the International Biological Program was to identify and seek recognition of significant natural ecosystems for long-term management and protection.

By 1974, two northern panels identified and described approximately 150 candidate sites. In 1975 an Interdepartmental Working Group on International Biological Program sites reviewed seven candidate sites. Only Polar Bear Pass was accepted by the Minister of Indian Affairs and Northern Development. No further proposals have been forthcoming from the Interdepartmental Working Group. International Biological Program sites receive some protection under the land use permit system. However, regulations do not provide long-term protection or the management necessary to meet the objectives of the International Biological Program.

Of the some 150 sites, 26 have been transferred from Indian Affairs and Northern Development's jurisdiction to specific conservation agencies or have been included in native claims. There are 48 sites which are only of interest to the International Biological Program panels (Crook and King, 1985).

Canada has been party to the United Nations Education, Scientific and Cultural Organization's (Unesco) World Heritage Convention since 1976. The Convention gives recognition to and provides for the protection of cultural and natural properties throughout the world which are considered to be of "outstanding universal value." Nahanni, Kluane and Wood Buffalo National Parks are on the World Heritage List. Other sites in the territories are likely to be nominated once they receive legislated protection.

Another Unesco program called Man and the Biosphere should have future application in northern Canada. Biosphere reserves, in accord with the Man and Biosphere Program are intended to protect "'cores' of undisturbed natural areas together with adjacent landscapes which have been modified by the activities of man." Future opportunities will abound in the territories to monitor developing patterns of human use against areas protected from change. Northern Yukon National Park and the remainder of the North Slope should be considered for Biosphere Reserve designation because both of the required components (human use and preservation) are present side by side.

Canada subscribes to the World Conservation Strategy of 1980 which urgently calls on governments:

> to maintain essential ecological processes and life support systems;
> to preserve genetic diversity;
> to ensure the sustainable utilization of species and ecosystems (International Union for the Conservation of Nature, 1980).

Both the Department of Indian Affairs and Northern Development and the Department of the Environment have embraced the strategy in their own policies. It has been widely accepted in principle and now requires application.

PRESENT SYSTEM AND FUTURE PLANS FOR NATIONAL PARKS IN THE TERRITORIES

The present system of national parks in the territories consists of two national parks and three national park reserves. Together they constitute 1.7 per cent of the territorial land mass. The total national park system, when complete, will not exceed 5 per cent of the combined area of the Yukon and Northwest Territories.

The approach used by Parks Canada to identify potential national park areas has been based on the concept of representation. Out of the 39 natural regions in the country, 15 are located in the territories. Park boundaries are determined by such considerations as the diversity of natural features, the need to accommodate future visitor demand, and the need to exclude areas of high mineral potential. National parks are not established where settlements already exist and new settlements are not permitted to develop within them. Efforts are made to ensure that nearby communities derive economic benefit from new parks.

Current initiatives include Ellesmere Island and the East Arm of Great Slave Lake. Both of these areas were withdrawn and protected under the *Territorial Lands Act* until further action toward national park reserve status can be taken. Other initiatives for which lands have not been withdrawn are North Baffin, Banks Island, Wager Bay and Bathurst Inlet. North Baffin was presented as a proposed national park in 1981 in the Lancaster Sound Regional Study and discussed with local people. Banks Island, Wager Bay and Bathurst Inlet were announced in 1978 as part of the "6 North of 60" public consultation program. Potential national park areas which have not been presented as formal proposals are Caribou Hills/Napoiak Channel in the Mackenzie Delta area, Bjorne Peninsula on Ellesmere Island, and possibly an area on Southampton Island.

The establishment of these 10 areas would round out representation of all natural regions in the territories.

Parks Canada's draft national marine park policy identifies 10 marine regions for Canada in the Arctic Ocean. An 1150 square kilometre representation of the Eastern Baffin Island Shelf is contained within Auyuittuq National Park Reserve and a marine component has been proposed adjacent to Northern Yukon National Park and in the Bylot Island-North Baffin area of Lancaster Sound. It is the long-term objective of the federal government to establish a representative example of each marine region as a national marine park, subject to the outcome of consultations on the draft marine park policy.

Three other Parks Canada initiatives will have a bearing on conservation of northern lands. These cooperative programs are the Canadian Heritage Rivers Systems, Cooperative Heritage Areas, and Canadian Landmarks. The objective of the Canadian Heritage Rivers System is to give recognition to naturally and historically important rivers and to manage them for public benefit. Both territories have joined the program. The Alsek River in the Yukon and the Nahanni River in the Northwest Territories have been designated as part of the system.

Currently there are no Cooperative Heritage Areas in the territories. The Yukon River was considered under the program in the past but plans for it did not materialize. The Government of the Northwest Territories favours the designation of the Canol Road, a remnant from World War II, as a Cooperative Heritage Area.

The Canadian Landmark program is designed to protect sites that are generally small, containing rare, unique, or exceptional natural features or phenomena of national interest. Nelson Head on Banks Island and the pingos of Tuktoyaktuk are candidates for Canadian Landmark designation. Both are contained in the Western Inuvialuit Settlement Agreement.

There have been many calls for Parks Canada to declare its long-term plan for the territories. This has been done in various places and forms such as draft reports, public presentations and published papers. The most recent effort at articulating the Department of the Environment's northern plans has suffered lengthy delays and the draft report has been strongly criticized by outside reviewers.

Territorial governments have viewed the department's earlier draft plans as overly ambitious and the proposed schedules too hasty. The plans were perceived as blueprints for aggressive federal action and labelled as "land grabs". Emphasis on resources, area identification, and selection, without prior involvement of the territories, was regarded as an exercise in "top down" decision making. That Parks Canada was applying an establishment procedure rooted in the 1960s was demonstrated by the slow progress of the northern parks program and by the ability of territorial governments to hold off precipitous federal action. By contrast, progress has been possible, as in the case of Ellesmere Island, where opportunities for joint decision making were present.

Present System of and Future Plans for National Wildlife Area and Migratory Bird Sanctuaries in the Territories

Since 1969, the Canadian Wildlife Service has been systematically identifying and describing areas that support significant wildlife. Because many species of migratory birds have diverse habitat, and because the territories are vast, information about many areas is still incomplete. This is particularly true of Yukon. In order to facilitate the selection of candidate areas for National Wildlife Area or Migratory Bird Sanctuary designation, both qualitative and quantitative criteria were developed which reflect the 1971 Ramsar Convention on wetlands of international importance. Qualitative criteria take into account ecological importance, diversity, fragility, research, and the educational value of sites as well as whether endangered or threatened species are involved.

The existing system of migratory bird sanctuaries consists of 13 sites, all located in the Northwest Territories. These are: McConnell River, Harry Gibbons, East Bay, Cape Dorset, Dewey Soper, Bylot Island, Seymour Island, Banks Island (2 sites), Kendall Island, Anderson River Delta, Cape Parry, and Queen Maud Gulf migratory bird sanctuaries. They range in size from 2 square kilometres to nearly 63,000. The total area covered by migratory bird sanctuaries is 109,086 square kilometres.

Priority areas for migratory bird sanctuaries are Prince Leopold Island in Lancaster Sound and Caped Searle and Reid Bay on the east coast of Baffin Island. Prince Leopold Island has significant populations of northern fulmar, black-legged kittiwake, thick-billed murre and black guillemot. The latter two sites are important to northern fulmar and thick-billed murre respectively.

The Canadian Wildlife Service has identified 16 other sites of international importance requiring statutory protection indicating that the system of migratory bird sanctuaries is far from complete.

The Canadian Wildlife Service has not indicated its intent with respect to national wildlife areas in the territories beyond Polar Bear Pass. This could be due to the jurisdictional uncertainty as to federal responsibility for wildlife and the lack of resources for expanding the program. In view of some, this will leave a gap in federal participation in the management of territorial wildlife.

Institutional Arrangements

Land Management

Lands north of 60° are federal Crown lands under the jurisdiction of the Department of Indian Affairs and Northern Development. Less than one per cent of the lands are Commissioner's lands under territorial control. The Department of Indian Affairs and Northern Development sees itself as the "trustee" of northern lands with defined roles: as the federal agency responsible for the control, management, and administration of public lands in the north; as the coordinator of government activities, programs and policies in the north; and as the formulator, coordinator and implementor of general northern policies (Department of Indian Affairs and Northern Development, 1982).

Despite these roles, the effectiveness of the Department of Indian Affairs and Northern Development as a conservation administrator has diminished since 1970 when the Canadian Wildlife Service was transferred to the newly created Department of the Environment. Parks Canada was transferred in 1979. The resolution of mineral development and conservation conflicts has been a major concern in northern national park establishment since the 1970s to the present. While Parks Canada was still part of the Department of Indian Affairs and Northern Development, competition for northern lands was acted out within departmental confines. Although seemingly an awkward arrangement, responsibility assigned to the same minister for both northern development and northern conservation created useful checks and balances in the bureaucratic and political decision making process. The effect of placing Parks Canada and the Canadian Wildlife Service in the Department of the Environment meant the loss of a direct access by these agencies to the Minister responsible for northern lands and a major loss of a conservation voice in the department administering these lands.

The Department of Indian Affairs and Northern Development's main instruments for conservation are the *Territorial Lands Act (1950 and 1975)* which enables the department to effect Order-in-Council withdrawals of lands, and the Territorial Land Use Regulations.

Northern Yukon, East Arm of Great Slave Lake, and Ellesmere Island are examples of Order-in-Council withdrawals for conservation purposes. Land Use Regulations are used to provide protection by restricting development activities and operations.

Although no panacea for all northern land management issues, potentially the most effective tool for land management is the proposed Northern Land Use Planning introduced in a draft policy form in 1982. This initiative is the first attempt to plan land and resource development in a coordinated and comprehensive manner. It is recognized as a primary vehicle for implementing conservation initiatives. Delays have been encountered in starting up the program and until recently its future seemed uncertain. This year, however, it received the necessary federal funding and may proceed in the Northwest Territories. In Yukon further progress must await the signing of an agreement between the federal government and the Government of Yukon.

Next to the Department of Indian Affairs and Northern Development, the Department of the Environment is the largest land manager in the territories. Approximately 4.4 per cent of all land and fresh water areas are protected under the *National Parks Act (1983)*, the *Migratory Bird Convention Act (1917)*, and the *Canada Wildlife Act (1973)*. The legal mandate under these acts is confined to migratory birds and the conservation of their habitats. Conservation interests are also served by the Federal Environmental Assessment and Review Office which reports to the Minister of the Department of the Environment. The Environmental Assessment and Review Process was established in 1973 to ensure consideration of the environmental effects of proposed development projects. Since there is no enactment to provide a legal basis for environmental assessment as in the United States, the implementation of the Environmental Assessment and Review Process has been criticized and its usefulness questioned (Rueggeberg and Thompson, 1984).

Territorial governments have very limited control over northern lands. One area in which territorial governments have responsibility is the preservation of game under the *Northwest Territories Wildlife Ordinance* and the *Yukon Game Ordinance.* In addition, territorial governments are responsible for the fledgling territorial parks systems. The total area of territorial parks or park reserves, game reserves, and sanctuaries is 3.1 per cent of the entire northern lands (Environment Canada, 1983).

Over the last few years native claims negotiations have become the most significant institutional arrangement affecting conservation initiatives in the north. Although underway since 1973, it was not until 1978 with the signing of the Committee for the Original Peoples' Entitlement Agreement in Principle that federal conservation initiatives were introduced at the negotiation table. The 1978 document called for the establishment of a "national wilderness park" under the *National Parks Act.* Since 1979, the native claims process has been a primary focus for reaching decisions on new national parks, migratory bird sanctuaries, and national wildlife areas.

As a result of the Committee for the Original Peoples' Entitlement settlement, Northern Yukon National Park and a conservation regime east of it were created in 1984. The Council for Yukon Indians Agreement-in-Principle refers to the establishment of a national park in the Old Crow Flats, and the Tungavik Federation of Nunavut Agreement-in-Principle calls for three national parks in Nunavut. Recently the Dene/Metis people have indicated that they wish to consider federal conservation proposals during land claims negotiations. Mutual interest in conservation would seem to imply a natural bond between conservationists and native people. Cooperation on conservation initiatives, however, has rested on the accommodation of native interests and concerns in return for native support (Kovacs, 1984).

Legislation

There is a broad range of existing legislation to provide for adequate northern conservation. Some 35 federal acts and territorial ordinances contain environmental provisions pertaining to the north (Department of the Environment, 1983). As well, Canada is party to a number of international conventions that have relevance to the north. Some of the most important pieces of legislation are: *Canada Wildlife Act*, *Migratory Birds Convention Act*, *National Parks Act*, *Territorial Lands Act and Land Use Regulations*, *Northwest Territories Ordinances* (Historical Resources Ordinance, Territorial Parks Ordinance, Wildlife Ordinance) and *Yukon Territory Ordinances* (Game Ordinance, Historic Sites and Monuments Ordinance, Parks Ordinance).

Despite the large number and diversity of pertinent legislation, there are gaps and weaknesses in the legislative base as the Northern Conservation Task Force and authors such as Bailey (1975), Hunt (1976) and Nelson and Jessen (1983) have observed:

- most acts do not provide for active management of natural resources; they are restrictive in nature;
- much of the legislation is sectoral with no provision for integrated resource management;
- overlap in legislation results in duplication, federal-territorial tension and interdepartmental competition (Task Force on Northern Conservation, 1984, p. 32).

In Bailey's view the real problem is the lack of effectiveness in the administration and enforcement of existing legislation (Bailey, 1975).

Policies

In addition to laws, policies relating to the north have been promulgated by federal departments and programs to articulate conservation priorities, direction, and intent. The most relevant are the policies of the Department of Indian Affairs and Northern Development and the Department of the Environment.

The Department of Indian Affairs and Northern Development's policy of "balanced" development was introduced in 1969. This policy stems from the recognition that the northern environment requires protection in face of increasing resource development and rests on the belief that both conservation and development objectives can be met. Critics have observed that the "balance" so far has been more rhetorical than real as industrial developments proceeded during the 1970s while conservation efforts lagged.

In 1982, recognizing the lack of progress in northern conservation, the Department of Indian Affairs and Northern Development issued a draft discussion paper on a comprehensive conservation policy and strategy for the territories (Department of Indian Affairs and Northern Development, 1982). This paper adhered to the department's long-standing policy of "balanced" development and called for the application of conservation measures cross-sectorally. It also called for the observation of the four elements of conservation as land management systems are put in place: preservation, protection, managed-use, and restoration. The paper emphasized the need for a comprehensive approach that addresses all land, fresh water and marine conservation needs. These and other elements of the suggested policy appeared in the report of the Task Force on Northern Conservation. The discussion paper and the Task Force report are serious attempts to redress the neglect of northern conservation during the past decade. The report of the Task Force is a benchmark effort against which future action will be measured. It has not yet received the attention it deserves.

In 1979 Parks Canada updated its existing policies and introduced policies for new program initiatives (Parks Canada, 1979). Most notably the revised policy included provisions for consultation with territorial governments and local people, for setting lands aside as national park "reserves" until native claims are settled, for conducting non-renewable resource inventories prior to formal park establishment, and for joint management regimes with native people. These policies have not been fully applied; however, they indicated an awareness of the special northern circumstances. The Canadian Wildlife Service has no similar formal policies for native involvement. However, there is strong support for such action at the staff level.

In 1983 the Department of the Environment released its policy discussion paper, entitled *Environment Canada and the North*, to review the department's responsibilities in the territories. The primary policy statement in the paper called for the establishment of a comprehensive network of areas in the north to protect significant aspects of Canada's natural and cultural heritage (Environment Canada, 1983, p.31). Two policies in the paper referred to consultation and cooperation with territorial governments and northern native organizations in matters of environmental management and in the training of native northerners. To date the call for comprehensive action in the Task Force on Northern Conservation Report and in the federal discussion papers has not been met by government action. The federal election of 1984 has put on hold efforts toward a major thrust in comprehensive conservation in the north. Under present economic policies and political direction, the horizon for completing the northern conservation system has been extended to spread out the financial burden of new initiatives over a longer timeframe and to conform with the consultative and cooperative approach emphasized by the new federal government. In any event, comprehensive action, as a matter of urgent priority, was opposed by territorial governments, native organizations and the Department of Indian Affairs and Northern Development. The idea never passed the recommendation stage.

Territorial governments have no formally adopted policies for cooperation with the federal government on protected area establishment and management; nevertheless, they have practiced cooperation as the examples of the Northern Yukon National Park and the Polar Bear Pass National Wildlife Area demonstrate.

Native peoples' policies for cooperation are clearly reflected in the Western Inuvialuit Agreement, the Wildlife Provisions of the Tungavik Federation of Nunavut Agreement in Principle, and in their wish to become involved in the management of national wildlife areas.

Other Institutions

Other forms of institutional arrangements are advisory bodies and committees at the federal level and between the federal and territorial governments. Examples of these are the Canadian Environmental Advisory Council, Northern Land Use Policy Committee, Consultative Committees on Park Matters between Parks Canada and territorial counterparts in both Yukon and the Northwest Territories. Through the latter mechanism, Parks Canada has agreed to a national park establishment process in the Northwest Territories and has been working with the territorial government toward the establishment of Ellesmere Island National Park Reserve. There are also advisory and management bodies stemming from consultative and cooperative action between the federal government and native people as a result of the native claims process. Examples of such existing and proposed advisory bodies are the Wildlife Management Advisory Council for the North Slope, the Inuvialuit Game Council, the Nunavut Wildlife Management Board, and the Grise Fiord Advisory Board for Ellesmere Island National Park Reserve. Clearly, these are institutional responses to increasingly cooperative action. By their nature and purpose they redefine the traditional roles of institutions and create new relationships in which decision making is a shared responsibility.

In addition, there are special interest groups and institutions dedicated to northern issues who bear considerable influence on northern land use decisions through lobbying and pressure tactics. The Canadian Arctic Resources Committee has been an effective voice for the rational use of northern resources. The Canadian Nature Federation, the Arctic International Wildlife Range Society, the BC and Yukon Chamber of Mines and the NWT Chamber of Mines are examples of special interest groups which have been actively involved in northern conservation issues.

As evident, there is a large body of institutional arrangements relating to northern conservation, to an extent that institutions may get in the way of effective conservation. This possibility was examined by Rueggeberg and Thompson (1984). Another study declared that in the Northwest Territories "institutional arrangements constitute a complex and poorly understood system of laws, policies and regulations administered by various federal, territorial, regional and local governments and also involving non-government agencies" (Nelson and Jessen, 1984).

Since there has been no single coordinating body to ensure orderly consideration of conservation initiatives within a comprehensive framework, the institutional arrangements have resulted in resource conflict, interagency competition, uncertainty and polarization between conservationists and developers. The Task Force on Northern Conservation concluded that the existing reactive regulatory approach to resource administration and other institutional arrangements must be reviewed, coordinated and streamlined before an effective conservation strategy can be implemented.

In contrast, some progress has been made in the area of policy formulation, if not implementation, and considerable advances have been made in cooperative institutional arrangements between the federal and territorial governments and as a result of the native claims process. Although progress has not reached far enough, it has been in the right direction.

Issues and Conclusions

In brief, it can be seen that after the turn of the century, early concern for the disappearance of wildlife and the plight of native people have led to the creation of a vast system of arctic preserves, a process which was aided by Canada's wish to demonstrate sovereignty over its northernmost lands. After 1948, when the responsibility for game was transferred to the territories, the system of preserves was dismantled over 20 years. National parks were slow to appear in the territories, even though Wood Buffalo was established in 1922. With no national parks and three national park reserves in the territories, the northern park system is far from complete.

With the international migratory bird convention behind the program, the Canadian Wildlife Service has enjoyed a measure of success and, since 1957, established 13 migratory bird sanctuaries in the Northwest Territories. However, this number leaves the system less than half complete. Attempts to establish national wildlife areas in the territories under the *National Wildlife Act* have largely failed. Of the international programs those which could be accommodated within existing institutions, such as national parks, have gained a foothold. The International Biological Program sites did not receive the required support and must be viewed as an unsuccessful attempt at protecting key biological areas in the territories.

Territorial plans for establishing their own park systems have only been partially realized because they do not have control over the required lands.

Since the days of the arctic preserves, conservation has declined, just as the need for it has increased, particularly since the 1960s with the emergence of resource development and the proposals for megaprojects in the north.

Progress has been thwarted by insufficient institutional coordination of programs, by the complexity of legislation, by federal-territorial tension, by interagency competition, by the lack of regional land use planning and management programs, by the absence of better accord between conservationists and native people, by the seemingly uneven application of the "balanced" approach to northern development, and by want of political action. Northern conservation has not kept up with the rapid political and resource development that has characterized the north during the past two decades.

The foregoing indicates a number of issues which must be dealt with in order to advance the cause of conservation in the territories. These are discussed below under separate headings, recognizing that they are interrelated.

Public Support

The first requirement for progress is the recognition by all concerned that the northern environment in general, and specific sites and features in particular, must be protected. This is demonstrated by the situation of the late 1960s when environmental concerns were in the forefront of the public mind and demanded political action. The general awareness of the need for northern conservation has been raised by events such as the Berger Mackenzie Valley Pipeline Inquiry, the Lancaster Sound Regional Study, and the Beaufort Environmental Assessment Review Panel Hearings. However, governments, private institutions, and indeed the entire educational system have an important role in making Canadians sensitive to northern conservation requirements.

Political Will

Once there is a high level of public awareness of conservation requirements in the north, the ground is prepared for political action. Political will is essential for progress since all decisions, including those related to conservation, are made in a large part on the basis of political considerations. These require the demonstration of public support more than of resource and planning needs.

Cooperative Action

Political action requires cooperation among federal ministers and among federal and territorial counterparts, and native leaders. The Department of Indian Affairs and Northern Development should continue its efforts to coordinate activities and provide appropriate mechanisms for cooperative action. Since decision making is no longer monopolized by one party, no one can play a leadership role except in helping to set up institutions and procedures for collective decision making.

Clarification of Roles

Cooperation is not likely to result, however, unless some other blockages are also removed. First, a clarification of roles is necessary to reduce competition among the various federal agencies, and between the federal government and the territorial governments. An opportunity to develop concurrently with federal initiatives their own complementary system of parks would be well received by territorial governments and would make sense from a regional planning point of view.

Legislation and Policy Changes

A clearer definition of respective roles should be reflected in legislation, program objectives, and policy. Amendments are required which would remove uncertainty in roles and overlap in mandates. The World Conservation Strategy, supportive of international programs but adjusted to national, territorial and local needs, provides a solid philosophical base for all conservation agencies.

Changes in legislation are also required to offer greater opportunity for active management. Improved legislation should be aimed at both components of conservation: protected areas and wise land use, i.e., both "targeted" and "pervasive" aspects of conservation.

On the "targeted" side, a better definition of roles and mandates may lead to new categories of protected areas which would be set up to meet the special northern environmental, political, and cultural circumstances. It may lead to a redefinition of roles in resource management as the example of the new Northern Yukon National Park would indicate. Work done by Theberge *et al.*, (1980) and Nelson and Jessen (1984), in matching conservation needs with appropriate institutional arrangements point the way for mandate and role clarification, and legal and institutional changes. This approach is predicated on the idea that conservation per se, not institutions, is of primary importance. As part of this process, shared or joint management of protected areas along redefined responsibilities would have to be considered.

Innovation

Innovation may lead to modified national parks and protected areas. In order for these to develop, a degree of institutional flexibility will be required. National parks, for example, would have to deal with the territorial wish for greater involvement in resource management and for making national parks planned components of regional tourism. Territorial involvement in managing federal conservation areas might also be a cost effective way of applying scarce financial resources. The conduct of research, the management of national parks and national wildlife areas, and the provision of services in a contractual arrangement between the federal and territorial governments and native people have been suggested. Tourism is important to northern economies. It was Yukon's number one and the Northwest Territories' number two industry in 1984 and national and territorial parks are expected to contribute to northern economies. More deliberate attempts at coordinated regional planning would be necessary to ensure that both tourism and preservation objectives are met.

Local Benefit

Native people will soon become major land and resource managers in the territories as a result of the current political and land claim processes. Their support for national parks and protected area programs is essential. It will not be forthcoming, however, unless native people find meaningful roles in the decision making process involving resources on which they depend.

Local support is also essential to the process of protected area establishment. For this support to materialize, local people must also be involved in planning and management decisions. They have to perceive that there is a direct value to them from the existence of protected areas. The direct benefit to native people may be the protection of wildlife to allow harvest on a sustained yield basis or it may take the form of employment. If local people do not come to view protected areas as benefiting their own lives, future efforts to establish protected areas, or to manage existing ones, will be frustrated (Kovacs, 1984) (Dasmann, 1982).

Comprehensive Approach

In addition to the clarification of roles and the revision of legislation, a comprehensive framework is required to define the extent of protected area systems, the selection criteria for candidate areas, and the process by which they will be established. The Task Force on Northern Conservation and Nelson and Jessen (1984) have recommended advisory bodies involving wide representation to fulfill the need for an overall planning mechanism and plan. Such a plan is a basic requirement which, to this date, has been lacking. A form of advisory mechanism would seem necessary to perform a coordinating role in the short-term and assist in the implementation of Northern Land Use Planning in the long-term, since none of the existing organizations or agencies could play a leadership role acceptable to all parties.

Another requirement is to improve scientific research in the territories. To remove the paucity of baseline data and to place planning on firm footing, research will have to be undertaken to fill gaps in information, and to improve methods for selecting candidate areas.

Procedures of federal agencies which have stressed the identification of areas as the first step in the establishment process should be re-examined. Such emphasis on resources has been threatening to territorial governments and to local people. The processes would have to be revised to include local and regional participation in the initial stages, as in the case of the current Dene contract study funded by Parks Canada to determine local attitudes towards a national park in the East Arm of Great Slave Lake.

Northern Land Use Planning

The proper vehicle for comprehensive plan design and implementation is Northern Land Use Planning. Unfortunately, it is not yet operational. From the point of view of conservation its strengths are: the ability to address priority areas; broad-based involvement to incorporate national, regional and local concerns; the capability to deal with both "targetted" areas and with "pervasive" conservation in an integrated fashion; and the mechanism for bringing to reality the notion of "balance" in northern development. Northern Land Use Planning should be implemented without delay.

Native Claims

In practical terms, the settlement of native claims has been and will continue to be the most important decision making forum for land tenure and management. Since the protection of the natural environment has been central to native claims, the resolution of conservation issues in this forum is particularly appropriate. The process has the advantages of high political support and priority, all party participation, comprehensive treatment of issues, shared powers for decision making, and legislative backing to implement agreements. The settlement of outstanding claims is expected to set the overall pattern of northern land management within the next few years and to provide the framework for northern land use planning.

Conclusion

If the foregoing issues are addressed, progress will have been made toward a comprehensive, coordinated and cooperative institutional framework for establishing and managing protected areas. What will remain is competition for land and resources. However, this is not only unavoidable but a necessary ingredient to rational land use allocation. But, conservation planning must be recognized as the fundamental basis for comprehensive land use planning, i.e. identifying, describing and providing for protected areas is the most important first step. Viewed from a comprehensive land use planning perspective then, "conservation" and "development" will not be regarded as irreconcilable opposites but as legitimate components of integrated resource management.

The last issue is one of timing. There is no requirement to establish conservation systems overnight. Rather, what is required is orderly progress according to priorities. The time to initiate action should not be delayed, however, as conservation must be a part of the major political and development processes which will determine the future pattern of northern land tenure, management and use.

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Conservation in the Canadian Arctic with Special Emphasis on Territorial Parks

Gordon M. Hamre

Introduction

For the purposes of this paper, the Arctic is considered to be that area north of the northern limit of trees. In Canada, most of this region lies within the Northwest Territories, which is the area of principal concern in this paper.

The long history of conservation in the Canadian Arctic is described by Kovacs (this volume). A list of the current conservation areas is included here as Table 1. Briefly, there is one national park which offers the usual protection of resources but permits wildlife harvesting by Inuvialuit (the native people of the area), restricted only by laws of general application respecting public safety and conservation. There is one national park reserve, managed as is any Canadian national park except that the area is subject to land claims negotiations by native people, hence the boundaries may be adjusted. One area is reserved for national park purposes by an order in Council. This is essentially a statement of intent by the federal government and offers no protection to the land except that land use permits, such as are required for non-renewable resources development, might not be issued for certain activities by the federal Department of Indian Affairs and Northern Development.

Bird sanctuaries, and the *Migratory Birds Convention Act* under which they are created, protect migratory birds and their habitat (Canada, 1982). Bird sanctuaries cover large areas although many important areas are not protected. The legislation is restrictive in nature and offers little management flexibility. Native peoples are allowed to hunt, trap and fish elsewhere but migratory birds must be left undisturbed.

There is one national wildlife area protecting the Polar Bear Pass International Biological Program site. This was created under the *Canada Wildlife Act* which is permissive and offers managers some latitude in management decisions affecting land use (Canada, 1973).

There are two game sanctuaries managed jointly by the federal and Northwest Territorial governments.

Table 1: Conservation Areas in the Canadian Arctic

Name & Status	Location	Area (km²)	Responsible Agency & Legislation
Auyuittuq National Park Reserve	Baffin Island	21,471	DOE/Parks Canada – National Parks Act
Ellesmere Island – land reserved for national park purposes	Ellesmere Island	39,500	DIAND – Territorial Lands Act DOE/Park Canada – National Parks Act (once proclaimed by Act of Parliament)
Northern Yukon National Park	Yukon	10,000	COPE – Western Arctic (Inuvialuit) Claims Settlement Act DOE/Parks Canada – National Parks Act
Anderson River Delta Bird Sanctuary	Arctic coast	1,083	DOE/Canadian Wildlife Service – Migratory Birds Convention Act
Banks Island Bird Sanctuary No. 1	Banks Island	20,518	DOE/Canadian Wildlife Service – Migratory Birds Convention Act
Banks Island Bird Sanctuary No. 2	Banks Island	140	DOE/Canadian Wildlife Service – Migratory Birds Convention Act
Bylot Island Bird Sanctuary	Bylot Island	17,920	DOE/Canadian Wildlife Service – Migratory Birds Convention Act
Cape Dorset Bird Sanctuary	Hudson Strait	259	DOE/Canadian Wildlife Service – Migratory Birds Convention Act
Cape Parry Bird Sanctuary	Amundsen Gulf	2	DOE/Canadian Wildlife Service – Migratory Birds Convention Act
Dewey Soper Bird Sanctuary	Baffin Island	8,160	DOE/Canadian Wildlife Service – Migratory Birds Convention Act
East Bay Bird Sanctuary	Southampton Island	1,166	DOE/Canadian Wildlife Service – Migratory Birds Convention Act
Harry Gibbons Bird Sanctuary	Southampton Island	1,489	DOE/Canadian Wildlife Service – Migratory Birds Convention Act
Kendall Island Bird Sanctuary	Mackenzie River delta	606	DOE/Canadian Wildlife Service – Migratory Birds Convention Act
McConnell River Bird Sanctuary	Hudson Bay coast	329	DOE/Canadian Wildlife Service – Migratory Birds Convention Act
Queen Maud Gulf Bird Sanctuary	Arctic coast	62,782	DOE/Canadian Wildlife Service – Migratory Birds Convention Act
Polar Bear Pass National Wildlife Area	Bathurst Island	2,624	DOE/Canadian Wildlife Service – Canada Wildlife Act DRR – Wildlife Act
Thelon Game Sanctuary	Central mainland Northwest Territories	23,960	DIAND – Territorial Lands Act (Land Use Regulations) DRR – Wildlife Act
Bowman Bay Game Sanctuary	Within Dewey Soper Bird Sanctuary	1,079	DIAND – Territorial Lands Act (Land Use Regulations) DRR – Wildlife Act

Name & Status	Location	Area (km^2)	Responsible Agency & Legislation
Campbell Hills/Campbell Lake Territorial Park proposal	Mackenzie River delta	Under negotiation	DEDT - Territorial Parks Act (once the land is alienated from the federal government) Possibly also land claims settlement legislation
Herschel Island Territorial Park proposal	Yukon Arctic coast	Subject to consultation	COPE - Western Arctic (Inuvialuit) Claims Settlement Act DCTS - Parks Act

COPE: Committee for Original Peoples' Entitlement, representing the Inuvialuit of the Inuvialuit Settlement Region
DCTS: Department of Community and Transportation Services, Government of the Yukon Territory
DEDT: Department of Economic Development and Tourism, Government of the Northwest Territories.
DIAND: Department of Indian Affairs and Northern Development, Government of Canada
DOE: Department of the Environment, Government of Canada
DRR: Department of Renewable Resources, Government of the Northwest Territories

There are no territorial parks in Yukon for which the formal establishment process has been completed, hence none enjoys the full benefits of protection under Yukon's *Parks Act*. In the Northwest Territories only a few parks exist in the arctic region and none plays a significant conservation role.

The Federal Government's Approach

Past approaches to conservation in Canada have brought about some of the world's greatest national parks and bird sanctuaries. But as in southern Canada, where most were established before the federal authority had to take into account provincial rights, most arctic national parks and preserves have been created by federal fiat with little consultation with the people or their elected representatives.

This is accounted for in large part by the low population density. Vast areas of the North are uninhabited. It was only in 1953, for example, that Inuit were moved from northern Quebec to establish Grise Fiord, Canada's northern-most non-military community, on Ellesmere Island. This relocation ostensibly was to alleviate poor economic conditions but had at least as important a role in asserting Canadian sovereignty in the high Arctic.

A decade ago Territorial Councils were established in Yukon and the Northwest Territories. This limited devolution of power offered the opportunity for federal agencies to consult with a resident government. Equally, it marked the end of unilateral federal action. Since that time there have been substantive negotiations with the northern governments for one arctic national park and one wildlife area.

Parks Canada's approach to national parks has been governed largely by its National Parks System Planning Manual (Parks Canada, 1971). The manual identifies natural regions based on biological and physiographic characteristics. There are twelve such terrestrial natural regions which are entirely or in part north of the treeline plus three marine natural regions. Within each, discrete areas known as Natural Areas of Canadian Significance are identified and ranked according to how well they represent the natural region. The preferred area is then selected according to this and other factors such as lack of conflicting land uses, practicablity and expedience. Public consultations follow.

The most important current factor in the creation of national parks (and other conservation areas) is the settlement of native land claims. To enable the federal government to proceed with at least some proposals, the *National Parks Act* was amended in 1974 to allow the Governor in Council to set aside land as a reserve for a national park pending a settlement in respect of any right, title or interest of the people of native origin therein (Canada, 1974). The *National Parks Act* applies in these reserves, although native people are permitted to exercise their traditional hunting, fishing and trapping activities. During any subsequent land claims settlement process, qualified native people may claim all or part of the national park reserve or may insist on continued right of access for hunting, fishing and trapping.

This change in the legislation made possible the creation of Auyuittuq National Park Reserve on Baffin Island, as well as some other park reserves in the sub-arctic.

In the western Canadian Arctic, Northern Yukon National Park was created in 1984 as part of the settlement of the claim of the Committee for Original Peoples' Entitlement, representing the Inuvialuit of the Inuvialuit Settlement Region (Canada, 1984). It never existed as a national park reserve and is unlike any other Canadian national park. The agreement and legislation by which the park was created provide for the protection of the wilderness characteristics of the area. Maintenance of its present undeveloped state to the greatest extent possible, and protection and management of the wildlife populations and the wildlife habitat are foremost in importance. Any change in character of the national park requires the consent of the Inuvialuit. In spite of these preservation measures, the Inuvialuit Final Agreement (declared valid by the Act *op. cit.*) provides, in a carefully circumscribed manner, for the limited and temporary use of part of Stokes Point within the park in support of hydrocarbon development (Indian and Northern Affairs Canada, 1984). These provisions for strict protection and also for non-renewable resource development create precedents for future national parks in Canada; their consequences are yet to be seen.

Other sections of the Inuvialuit Final Agreement require the creation of a Canadian Landmark to protect pingos near Tuktoyaktuk. It would be managed under the *National Parks Act*. As yet the federal government has made no move to amend the legislation to provide for a landmark program. According to the Agreement, a second landmark could be created on Banks Island in exchange for the Inuvialuit receiving title to equivalent land elsewhere.

The Territorial Government's Approach

The Government of the Northwest Territories is pragmatic in its approach to national parks and the like. It supports the concepts of preservation and conservation of historic, natural and cultural sites but believes that these concepts cannot be applied using criteria which have largely evolved from a southern Canadian perspective (Braden, 1980). The government will press its federal counterpart to ensure that northern interests, particularly the rights of native peoples and, more generally, economic development opportunities are considered in any plans for conservation.

The Government of the Northwest Territories' view is rooted in a belief that a national park is a use of the land. It is but one of a number of prospective developments which could take place in a given area. As such, it might be imagined that a national park could compete with a non-renewable resource development such as a mine. In practice this should not happen because it is Parks Canada's policy to have the Department of Indian Affairs and Northern Development determine the non-renewable natural resource potential of candidate park areas (Parks Canada, 1979). Areas with significant potential are dropped from further consideration. Nonetheless, because national parks can have an impact upon areas and development proposals far beyond their boundaries, they are viewed with some scepticism and apprehension because they may become serious constraints to future development in a park of the country where employment and economic development opportunities are few.

Significant economic benefits can accrue from national parks. Their overall impact on the northern economy is substantial and compares favourably with that of other renewable resource based industries (Inter Group, 1985). The benefits, especially from spin-offs like tourism, which is the second most important industry in the Northwest Territories, can be substantial in communities where other employment opportunities are virtually absent. Both government and the Travel Industry Association of the Northwest Territories see parks as one means of augmenting tourism (Anonymous, 1985). It is for these tourism benefits, or at least for conditions which would allow tourism to flourish, that the Government of the Northwest Territories argues most strongly in negotiations with the federal agency over national parks.

The attitude of the Government of the Northwest Territories towards federal parks is carried over to its own system. Territorial parks are created primarily for recreational purposes, either to provide facilities for local residents or to support tourism which in turn contributes to economic development. Five categories are provided for in the legislation: natural environment recreation parks, outdoor recreation parks, community parks, wayside parks, and historic parks (Northwest Territories, 1973).

Conservation in these parks focusses on preserving the basic resource around which the park is developed. In outdoor recreation parks (at the time of writing there were no natural environment recreation parks) the goal is analogous to that of a business which safeguards the future of its investment by securing the best possible physical plant at start-up and by maintaining it well. Creation of a territorial park is not the mechanism of choice to protect an environmentally important or sensitive resource. Equally, territorial parks are not seen by the territorial government as a land banking mechanism; the size will not exceed anticipated needs for developments, recreation, buffer zones, and so on. They will not duplicate the functions of wildlife reserves, migratory bird sanctuaries, or national parks.

This is not to imply a cavalier attitude towards conservation in territorial parks. Rather, a significant effort at conservation of the natural resources is not warranted at this time. The total land area in the three dozen or so territorial parks in both the arctic and sub-arctic regions of the Northwest Territories is less than 30 square kilometres.

In historic parks, on the other hand, protection of archaeological resources may be paramount. Some eastern Arctic communities have sought territorial parks at important cultural heritage sites. Reasons are varied but besides the protection aspect common to all, they include opportunities for tourism and economic spin-offs, commemoration of local heritage, and a preference for territorial rather than federal government involvement. A case in point is the current move to create a territorial historic park at Kekerten Island in Cumberland Sound to commemorate Inuit involvement in whaling in the eastern Arctic.

In a few communities, the people have rejected the notion of a government park and the restrictions such a designation might bring. For example, a Thule site on the Meliadine River is listed in the regulations under the *Territorial Parks Act* although alienation of the land from the federal government is not complete. The territorial government does not plan to proceed with alienation because such a move would not enjoy the support of residents of nearby Rankin Inlet who have declare the area to be a community historic site (Ian Kinsey, personal communication, 1985). Government officials are exploring innovative means of supporting this initiative but without the trappings of territorial park designation. The intent is both to protect the site, which has been studied by archaeologists from the Prince of Wales Northern Heritage Centre, and to promote it as a tourism feature of Rankin Inlet. Any development or promotion will respect the community's wishes and will recognize the importance of the site in the cultural heritage of the Inuit.

Notwithstanding the reservations of residents of some communities, in general prospects for the creation of territorial parks appear to be good. In 1983, the Tungavik Federation of Nunavut, representing the Inuit of the eastern Arctic in land claims negotiations, initialed an agreement-in-principle with the governments of Canada and of the Northwest Territories which endorsed the desireability of establishing territorial parks (Anonymous, 1983). The agreement-in-principle contains clear provisions for the involvement of Inuit and other local residents in the planning and management of territorial parks. As well, any matter connected with a proposed park that would have a detrimental impact on Inuit or that could reasonably confer a benefit may be subject to negotiation and inclusion in an Inuit Impact and Benefit Agreement. A similar agreement-in-principles with like provisions was initialed respecting national parks.

At one time, the Government of the Northwest Territories supported the parallel establishment of territorial recreation parks and national parks to correct the "lopsidedness" which was developing in favour of the conservation-oriented federal system (Hodgson, 1979). Since then, and with the support of Parks Canada, the territorial government has moved independently to expand its own park system and now relies on the federal government to provide for visitation to national parks. The agreement negotiated (but not signed as of this writing) to establish a national park reserve at the northern end of Ellesmere Island illustrates this cooperation (Government of the Northwest Territories and Parks Canada, 1985).

Responsible agencies must address the need to provide for some level of access to resources and features of public interest, be they national parks, sanctuaries, reserves, or without formal designation, even if that access must be controlled or denied under prescribed circumstances. The apprehensions of researchers such as England (1982) that visitors may alter or destroy high Arctic landscapes may be well founded. However any proposal which prohibits visitation on these grounds alone is untenable. And widespread dispersal of small groups will only mean facing the problems of impact at a future date and ignores practical considerations of access, accommodation, and desire to visit known features. Indeed, the researchers who visit the Arctic are themselves tourists and are so documented in travel industry statistics.

Increased visitation to the Arctic is an inevitable consequence of increased awareness of what the Arctic has to offer coupled with improved access to the North generally. For example, visitation to Auyuittuq National Park Reserve peaked a few years after the park was established in 1972, then declined, but has risen steadily since 1981. This contrasts with total attendance at national parks in Canada which has declined since 1980 (InterGroup Consultants Ltd., 1985; Parks Canada, 1985).

Put another way, tourism is a manifestation of public interest, public interest which is essential for government action to protect significant arctic resources.

A system of territorial parks, each designed and developed to accommodate visitors and part of a comprehensive tourism program, may offer a practicable solution to the need to reconcile tourism and a sensitive environment. Paired with attractive features and managed to ensure their protection, territorial parks could become part of a sound environmental management approach to the Arctic.

Conclusion

The challenge of work in the Arctic today is relevance. Conservation like all land uses, must be relevant to current and developing issues: settlement of land claims, sovereignty, defence of the western hemisphere, resource exploration and development, and rights of indigenous peoples to pursue traditional lifestyles, to name a few. Conservation must be part of the solution, not part of the problem.

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Protected Areas and National Parks in Greenland

Henning Meyer[1]

Introduction

Modern development, with growing population and the increased use of more and more advanced technology, and steadily increasing pressure on nature and its resources, has in Greenland–as in other Arctic regions in recent times–created a growing need for initiatives to protect natural assets.

It has never been difficult to create understanding for the need for such initiatives. The Greenlandic population has to a considerable degree carried on its ancestors' Eskimo hunting culture, and adapted it to present realities so well that by far the largest part of the population today is totally dependent upon the catch from hunting and fishing.

Hunting is still carried out to a considerable degree in harmony with old traditions. The use of snowmobiles (skidoos) has never gained a foothold, neither in the real hunting districts in North and East Greenland nor, for example, in connection with reindeer-hunting in West Greenland. Thus, the dogsled and kayak are still the means of transportation used for hunting. In contrast, fishing has been heavily industrialized, the fleets as well as the factories.

The relatively small population's (50,000 approximately) occupational dependence upon the living resources, and lifestyle in close contact with magnificent natural surroundings, have preserved a respectful attitude toward nature in wide circles. This attitude has, through the Greenlandic political organs, found expression in up-to-date legislation. Increased activity, within areas such as tourism and exploration for and exploitation of non-renewable resources, has in recent years created a special need for legislation and administrative control.

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[1] After preparing this valuable report, Henning Meyer passed away. The paper was presented at the Symposium by Morten Meldgaard.

Legislation and Authority

Until the introduction of Home Rule in Greenland in 1979, the highest political assembly was the Greenlandic Council, which had advisory capacities in relation to the Danish authorities. One exception was, however, regulation of hunting for mammals and birds, and fishing for salmon in streams and lakes. In these areas, the Greenlandic Council had legislative authority. For example, the earliest regulation of polar bear hunting, together with the complete protection of, among other species, the Greenlandic eagles, falcons and owls, stem from that period.

With the introduction of Home Rule, the newly formed Greenlandic Parliament took over legislative authority in a long list of areas. In that connection, legislation regarding the protection of nature, the preservation of *in situ* antiquities and buildings, and legislation regarding land use, shall be emphasized.

The law regarding the protection of nature has as its chief purpose to safeguard and care for Greenland's natural and scenic assets, and it gives authority to protect plant and animal species. Furthermore, areas can also be protected, where, for example, preservation or scientific considerations dictate it. Thus, the administration of the National Park in Northeast Greenland, established in 1974, is handled pursuant to provisions authorized in that law.

The law regarding preservation of *in situ* antiquities and buildings protects ruins, dwelling sites, tent rings, kitchen middens, graves, stone placements and the like, over all of Greenland. The law also determines how close to such *in situ* antiquities that activities may take place which could mar or harm the antiquity. Finally, the law provides for the preservation of historic value.

In Greenland, there is no right to private ownership of land. All land use that causes an area to be withdrawn from common usage by the public requires permission. In towns and built-up areas, permission is granted by the municipal councils, while permission regarding open land is granted by Greenland's Home Rule authorities. The granting of permission to use an area shall ensure that a series of purposes is fulfilled. These include, among others, that the land and its natural resources are utilized for the benefit of the society as a whole and that the use of the land be conducted in such a way as to prevent pollution of air, water and earth, to prevent noise nuisance, and to protect nature. Areas used for defense purposes and for pilot studies, prospecting for and exploitation of nonliving resources are exempted from the Home Rule authorities' competence to give permission for land use.

This complex of laws put into effect by Greenland's Home Rule authorities has established the necessary administrative basis to safeguard essential considerations regarding the land's environment. This legislation is supplemented by legislation passed by the Danish Parliament regarding areas for which Home Rule has not yet taken over legislative authority. Negotiations regarding these areas have, however, recently begun.

Among the essential laws passed by the Danish Parliament are a series of laws safeguarding the marine environment against land-based and sea-based pollution. Furthermore, it is reasonable to single out the agreement entered upon by Canada and Denmark in 1984 regarding cooperation for the protection of the marine environment between Greenland and Canada. Denmark/Greenland have, in addition, joined a series of international conventions, including the Washington Convention on International Trade with Animals and Plants Threatened with Extinction, and the Convention on International Protection of Polar Bears.

As mentioned above, the Home Rule authorities' competence to grant permission for land use does not encompass land use for pilot studies and exploration for and exploitation of non-living resources. Concessions for such activities are granted, pursuant to the 1974 Law on Mineral Resources in Greenland, by the Danish Kingdom, represented by the Minister for Greenland, who, however, can only grant a consession as long as there is Danish/Greenlandic agreement on it.

The question of granting concessions is considered in a Joint Council consisting of Danish and Greenlandic politicians, which can submit a recommendation to the authorities of the Danish Realm (the Danish Government) and to Greenland's Home Rule Government. On that basis the Danish Government and the Minister for Greenland can issue the concession. The Danish/Greenlandic Mineral Resources Agreement thus gives each party the right to veto the granting of an application for a concession.

An important provision of the law in relation to the environmental concerns is the provision that permission for pilot studies and the granting of exclusive rights to exploration and exploitation can, taking into consideration such factors as natural and building preservation as well as existing rights of usage, be granted over all of Greenland. A joint Danish/Greenlandic administration is attached to the Joint Council. The joint administration receives advice from, among others public environmental authorities and scientific institutions.

Regional Preservation

The more outstanding preserves of larger, regions, will be discussed below. Beyond these, there are also a series of smaller areas, such as, for example, bird cliffs, skerries and islands, where hunting, gathering, and egg-and-down-collecting are forbidden all year.

Greenland's climate varies from the high and low arctic to the subarctic, and true tree and forest growth is therefore a rarity. In the southernmost part of West Greenland there are, however, valleys with such a climate that birch, rowanberry and juniper have been able to develop larger continuous stands. These valleys were made preserves by the Greenlandic Council in 1962, so that all dwelling and all cutting of trees, and similar activities, are prohibited. Camping may take place with special precautions, and all hunting is forbidden except for winter hunting of foxes and ptarmigan. In South Greenland there is sheep-herding, but the sheep must not be allowed to encroach upon the protected areas.

Sheep-herding in South Greenland is, for that matter, an old occupation, since the Norsemen during the period from approximately the year 1000 to 1400s already engaged in significant sheep-farming. The land still bears many traces of this. The original growth of brush is gone, and it is possible that overgrazing, followed by heavy soil erosion, was a contributing cause of the Norsemen's abandonment of the land in the course of the 1400s.

In modern times, Greenlanders have taken up sheep-herding again, and there are now about 25,000 sheep in the area, with an annual lamb production of about 20,000. The initiation of significant expansion of sheepherding has caused worry over the environmental consequences. Therefore, a comprehensive research program to determine the area's grazing capacity is planned to be carried out in 1985. Furthermore, studies are being carried out regarding the most expedient cultivation methods, with the purpose of preserving the thinnest–and therefore most erosive–top soil. In that connection, protected areas are being laid out. These protected areas serve as so-called reference areas. They, and associated research shall create a basis for decisions regarding further regional preserves for the safeguarding of natural assets and recreational use, since a not insignificant tourist trade is about to be established in South Greenland. Finally, the very large number of ruins and evidence of Eskimo and Norse activity demand a series of special considerations.

Tourism and camping either in or near areas with antiquities have led to the creation of regional preserves in several places in West Greenland. For example, it became necessary to prohibit the landing of private planes in an area rich in archaeological sites not far from the air base at Sondre Stromfjord, which serves as the main port of entry to West Greenland. However, the municipal council may grant special permission to land in this area, where, additionally, every form of plant and animal life is completely protected. The purpose of these provisions is, together with a series of other regulations, to protect a wealth of antiquities, reindeerhunters' dwelling sites, hunting grounds, and graves of unique value for the cultural-historical description of that particular continental environment.

The reindeer populations have always been the most essential resource base for human existence in the land areas marked by a continental climate, in the inland parts of the fjords, and in the land zones near the Ice Cap's edge. In certain periods, these animals have been spread out over almost all of West, East, and North Greenland, but today they are found only in the most central part of West Greenland. There, the reindeer populations continue to represent a supplement to the meat supply at the same time that, during the hunt (which occurs during the months of August and September), old traditions are still maintained, albeit hard pressed by modern hunting methods and means of transportation. Hunting pressure is, though, no threat to the populations, since besides limitations on hunting, there are regional preserves covering at least one-fifth of the area of the districts which contain reindeer populations. In the preserves, the reindeer are completely protected.

The largest protected area in West Greenland is the preserve on Melville Bay between Upernavik and Thule, lying along the northernmost part of the West Coast. The region, which consists of approximately 8000 square kilometres of ocean, islands, coastland, nunataks and Ice Cap, was set aside as open wildlife preserve in 1980 at the initiative of the municipal councils of Thule and Upernavik. The intention was thereby to provide a refuge for the hunted animals which constitute the basis for existence of the municipalities' populations. The area is the only one in West Greenland, south of Thule, where polar bears are known to spend the winter and bear young. Furthermore, the region is an important breeding area for ringed seal (***Phoca hispida***) and rare species of arctic birds, for example, Sabine's gull (*Xema sabini*).

As early as in 1946, regulations were set down in Melville Bay for the protection of animal life. Among other activities, boating with motorboats is prohibited. In the nature preserve, all hunting, egg-collecting and traffic, as well as flying at altitudes of under 500 metres, are forbidden. The preserve is divided into two areas, one region near the coast, and one region encompassing the farthest islands and ocean reaches. Traditional hunting may, to a certain degree, still be carried out in the outer area, just as the region may be crossed by those travelling by dogsled between Thule and Upernavik. But dogsledding done for sport or tourism requires special permission, which is granted only exceptionally. Boating in the preserve may only take place in the outer region, and in that connection, one may not go ashore in the preserve. Scientific expeditions can be given permission for entry under special conditions.

The National Park in Northeast Greenland

A series of expeditions to North and Northeast Greenland before and after the turn of the century rapidly created a growing interest in possible exploitation of the area's rich wildlife. Thus, competing Danish and Norwegian hunting operations developed, aimed at the regions' big game: polar bear, arctic wolf, musk ox and walrus. The significant hunting pressure which was exercised upon these species led to great concern. Especially affected were the musk oxen, which, because of their defensive tactics, allow themselves to be easily surrounded and shot down in great numbers. But hunting of polar bears on the drift ice was also carried out too intensively to sustain a population which would ensure adequate reproduction in the long run. In that epoch in the first half of the century, there was no basis to implement limitations and protections.

However, conservation initiatives were not abandoned. In the winter of 1953-54, a catastrophe for the musk ox population occurred. Thousands of oxen died because of great amounts of snow and the icing up of vegetation. This catastrophe gave rise to renewed discussions on the introduction of regulations for the protection of wildlife. These discussions resulted in the Ministry for Greenland issuing, in 1956, an order regarding preservation in Northeast Greenland, in which, among others, all species of geese together with snowy owls (*Nyctea nyctea*), gyrfalcons (*Falco rusticolus*) and walrus were completely protected. Musk ox hunting was curtailed to a limited number of bulls per hunter, and polar bear cubs and their mothers were completely protected. Furthermore, a smaller area was zoned as a preserve.

In 1967, a 1924 agreement between Norway and Denmark regarding Norwegian hunting fights in Northeast Greenland expired. In the same year, a committee was appointed, whose task was to work out a proposal for a preservation law for all of Greenland. The idea of zoning parts of North and Northeast Greenland as a national park was also to be discussed.

Greenland's conservation law went into effect on 1 July 1974. With it, a region from Petermann's Glacier in North Greenland to Cape Biot, east of the Mesters Vig airstrip in East Greenland, together with the Greenlandic ocean territory along this stretch, was zoned as the National Park. The total area covers approximately 700,000 square kilometres, thereby making Greenland's National Park the largest in the world.

With the passing of the area of conservation to Home Rule in 1981, the administration of a National Park was transferred to the Greenlandic authorities. The National Park's administration is under the jurisdiction of the Home Rule Premier, who is advised by a special council consisting of members of Greenland's Parliament, and administrative and scientific experts.

In the regulations regarding the National Park, the purpose of the park is given as being the preservation of the region's natural condition, and at the same time also ensuring the possibility of research and public access. Birds and other animals are completely protected, but the populations of Thule and Scoresbysund municipalities, which border the park on the North and South, have retained the right to conduct traditional hunting and gathering in the park's ocean territory. The hunt must be conducted by dogsled, kayak or motorboat. In addition, the military patrols have limited permission to hunt. While they may catch seals for food for their dog teams, they may not hunt polar bears or musk oxen.

The natural environment must not be disturbed. Therefore, plants with roots, and crania and skeletal fragments, may not be removed without permission. Water courses may not be altered, and lakes and dams must not be filled up. New stations, cabins or other installations may not be established without permission from the Home Rule authorities, and garbage must not be left anywhere other than special, approved waste depositories. Antiquities and finds of historical or cultural-historical interest are, as in all of Greenland, protected in accordance with the Greenland Parliament's Law on the Preservation in *in situ* Antiquities and Buildings. But a special regulation for the National Park requires that *in situ* antiquities and their surroundings be left untouched by a distance of 100 metres, while the preservation distance in the rest of Greenland is only 20 metres. Cairns and messages left within them are also protected.

Aside from a few people employed at weather and military stations, the region is uninhabited. All others besides these individuals and the inhabitants of Thule and Scoresbysund are required to obtain special permission to enter the National Park. As mentioned, one of the purposes of the establishment of the National Park is to ensure access to the Public, and in principle, it is not desired to deny anyone access. But by requiring special permission for entry, one ensures that the individuals or expeditions which travel in the area know the regulations in force regarding the preservation and protection of nature. One wishes to ensure that they do not carry out activities which can have a damaging effect upon the condition of the park.

Furthermore, one must take into consideration that travelling in the park can pose a significant risk for one's life and health. Large parts of the National Park belong to the most desolate and inaccessible regions of the world, and limited resources are available for search-and-rescue operations. Often there will be great distances to the nearest place from which help can arrive, and one cannot be certain of being rescued if an accident occurs, because all available aircraft could be concentrated on important assignments elsewhere in Greenland. In addition, a search-and-rescue operation can easily cost several hundred thousand Danish crowns, and involve a real risk for the crew and equipment.

Therefore, detailed information regarding the expeditions desiring access to the National Park is required. It is necessary to know the purpose of the journey, whether the participants are used to travelling in that type of region, the precise travel route, the means of transportation to be used, and so on. This information is forwarded to the local authorities, including the police and defense forces, which handle the search-and-rescue service, and who must know where they should search in case an expedition has difficulties. Each expedition is obliged to cover all expenses which are incurred in connection with search-and-rescue operations. It can therefore be stipulated as a condition for an expedition's entry into the park, that security for such expenses be posted.

The Danish military sledge patrol, which has its headquarters at Daneborg, keeps check on who travels in the National Park. They see to it that the rules and regulations in force in the park, and that those conditions which were laid out to gain entry, are kept. Complete check on what is happening in this enormous land area is impossible. But the patrol has regular contact with the expeditions that–and that is by far most of them–are staying in the area between Daneborg and Mesters Vig.

The National Park is mainly travelled by scientific expeditions covering many different fields of research. Often the same people come year after year to conduct continuous research in the region. Research can involve studies of the habits of the musk ox or the polar bear, or the breeding conditions of geese, or it can be botanical research, measurements of the East Greenlandic ocean current, mapping of Eskimo dwelling sites, geological and glaciological studies, and so forth.

Applications from scientific expeditions are reviewed by the National Park Council, with assistance from the Commission for Scientific Research in Greenland. A recommendation is submitted to the Home Rule authorities regarding permission to the expedition in question, and, if permission is granted, under what conditions.

Other visits to the National Park are of a sporting nature. For example, mountain climbers come from many parts of the world to test their strength, especially on the alpine summits in the southern part of the park.

The main port of entry to the National Park has up to the present been the airfield at Mesters Vig in the southeastern part of the park. By far the majority of expeditions enter the park via Mesters Vig in the short season from May/June until August/September. However, the Mesters Vig airfield is to be closed down at the end of 1985. It is therefore not known how future access to the park will be secured.

In the Fall of 1985, the holder of a concession will construct a 900 metre-long runway at Hurry Fjord, approximately 200 kilometres farther south than Mesters Vig. That runway is part of a several-years long oil exploration program in the Jameson Land region north of Scoresbysund.

It is conceivable that this new runway will be able to take over the role of the Mesters Vig airstrip.

It must be admitted that development has brought in its wake increased need for control of traffic into and out of the National Park. Efforts will therefore be made toward a solution, whereby all traffic goes through the same airport, so that entries and exits can be monitored. Similarly, permission for landing in the park directly from a foreign country will only be granted in exceptional circumstances.

It is the goal of the Home Rule authorities to find a solution to the supervising functions and the possibilities of access to the National Park, which as far as possible considers the Greenlandic and international community's need for the preservation of the natural condition of the park.

Exploitation of Mineral Resources

In relationship to the size of the land, exploitation of the non-living resources until now has been very modest. Today, mining occurs in only one place, a single mine in West Greenland. Known pollution has been limited to local pollution of the marine environment, and continuous monitoring is conducted.

In recent years, however, quite comprehensive explorations for minerals and oil have begin. Both prospecting activity, and the expected exploitation, will create a need for measures to safeguard the natural environment as much as possible.

Already, as part of regular practice, comprehensive environmental background studies are carried out prior to, and at the same time as, prospecting. These studies normally include mapping of flora and fauna, and studies of nature's sensitivity to the expected physical effects. On that basis, decisions are made as to how the environmental considerations will influence the terms and conditions of the consessions. In addition, environmental supervision during the implementation phase of the activities is established.

Particularly the ongoing and very comprehensive exploration for oil in a large land area immediately south of the National Park will, despite comprehensive environmental background studies, be able to bring in its wake the risk of unfortunate effects upon the surrounding land and marine environment. These aspects have been strong elements in the political debate which has led to the permissions granted thus far.

Regarding possible exploitation, it will be the political authorities task to make decisions which represent a weighing of the commercial and economic interests as opposed to the environmental considerations.

National Parks and Protected Areas in Norway, with Particular Reference to the Arctic

Magnar Norderhaug

Introduction

The purpose of this paper is to present a brief outline of the conservation history and trends in establishment of national parks and protected areas in Norway. Particular reference is given to the establishment of protected areas in the Arctic archipelago of Svalbard, the northernmost part of Norway. Although the organization of the Norwegian conservation movement started in 1904, practical achievements were few, until the beginning of the 1960s. At that time, a new Nature Conservation Inspector had been established (1960). Compared with other Nordic countries, the breakthrough of nature conservation in Norway came late. The developments in the last two decades have, however, been rather significant.

A Brief Outline of the History of Nature Conservation in Norway.

The first Norwegian Nature Conservation Act entered into force in 1910. Soon after (1914) the Norwegian Nature Conservation Society was formed. This organization is still the most important of the Norwegian non-governmental conservation organizations. This society was the most important force in Norwegian nature conservation until the National Council for Nature Conservation was established in 1955. This Council organized the first systematic inventory of areas of conservation interest from 1960 and onwards. The first plan for a national parks system was presented to the Parliament in 1964, two years after the first Norwegian national park had been established. The Council furthermore initiated in 1962 systematic, nationwide inventories of important habitats including forest areas of high conservation interest, and important botanical and ornithological habitats. A further administrative development took place in 1965, when a national administration for nature conservation and outdoor recreation was established under one of the ministries. Five years later (1970) a new Nature Conservation Act replaced the 1955 legislation.

This act has since formed the legal basis for the establishment of all conservation areas in Norway. Finally, in 1972, the Norwegian Ministry of Environment was established. Subsequently conservation of national parks and nature reserves in Norway has gradually been improved and developed into a rather extensive network of protected areas.

Legislation and Administration

Protection of flora, fauna and natural areas, including geological features is primarily based on the Nature Conservation Act of 1970. Paragraph 1 in this Act provides the following definition of nature conservation:

> Nature is a natural asset which must be protected. Nature conservation means the management of natural resources, taking into account the close relationship between man and nature, and the need to preserve the quality of nature for the future. All persons shall show consideration and due care in their relationship with nature. Encroachments on nature should only be undertaken on the basis of a long-term and comprehensive management of resources based on the principle that nature in the future must be preserved as the basis for human activity, health and welfare.

As far as protection of fauna is concerned, a new Wildlife Act covering mammals, birds, reptiles and amphibians entered into force in 1982. In accordance with this Act, all wildlife is in principle totally protected unless hunting seasons are particularly specified. It should be furthermore added that Norway has ratified or signed most of the international agreements related to the protection of areas and threatened wildlife (Table 1).

The 1970 Nature Conservation Act provides the legal basis for the establishment of national parks, nature reserves, landscape protected areas, natural monuments and sites, and the protection of flora and fauna. The Ministry of Environment was established with responsibility for regional and urban planning, for the coordinated planning and management of water and land resources, for pollution control and noise abatement, problems of waste disposal, conservation of nature and recreation areas, management of game and fresh-water fish, preservation of cultural sites and monuments in town and country, and coordination of research and international cooperation in the field of environment. Subsequently, the Ministry was also given responsibility for long-term management of the country's natural resources. Administratively the Ministry is divided into five Departments:

- The General Coordination Department

Table 1 Norwegian adherence to international conventions or agreements related to nature conservation, per 15 May 1985.

Agreement	**Status 1985**
Global conventions	
International Convention for the Regulation of Whaling	Ratified 1948
Convention on International Trade in Endangered Species of Wild Flora and Fauna	Ratified 1976
Convention on Wetlands of International Importance Especially as Waterfowl Habitat	Ratified 1974
Convention concerning the Protection of the World Cultural and Natural Heritage	Ratified 1977
Convention on the Conservation of Migratory Species of Wild Animals	Ratified 1980
Regional conventions:	
The Antarctic Treaty	Ratified 1961
Convention for the Conservation of Antarctic Seals	Ratified 1973
Agreement on the Conservation of Polar Bears	Ratified 1975
Convention on the Conservation of Antarctic Marine Living Resources	Signed 1980
Convention on the Conservation of European Wildlife and Natural Habitats	Signed 1979

- The Department of Regional Planning
- The Department of Pollution Control
- The Department of Nature Conservation and Open-Air Recreation
- The Department of Natural Resources

The Nature Conservation and Open-Air Recreation Department administers the provisions of the Nature Conservation Act of 1970.

The Development of a Norwegian National Park System

The national park idea reached the Nordic countries shortly after the establishment of Yellowstone national park in 1872. In 1880, the Arctic explorer A.E. Nordenskiold suggested that national parks should also be established in the Nordic countries. In 1902, the first Norwegian national park proposal was presented by H. Reusch, one of the early conservation pioneers. Since then, and until the Second World War broke out, various national park proposals were prepared by the Norwegian Conservation Society and the Norwegian Tourist Society. However, time was not ripe.

The turning point came as late as in 1955, when the first National Council for Nature Conservation was appointed by the government. In 1964, two parks had already been established:

- Rondane national park in 1962 (exactly 60 years after the first park was proposed).
- Borgefjell national park in 1963.

In general, the national park plan was well received by the Parliament. It was adopted in 1967 and has since then formed the basis for the establishment of national parks in Norway. Today, this plan has in principle been almost fully implemented (Figures 1-2, Table 2).

At the end of the 1970s it was, however, also evident that the national park system was far from complete, since significant parts of Norwegian nature were not represented. On this basis, work on a second plan has begun.

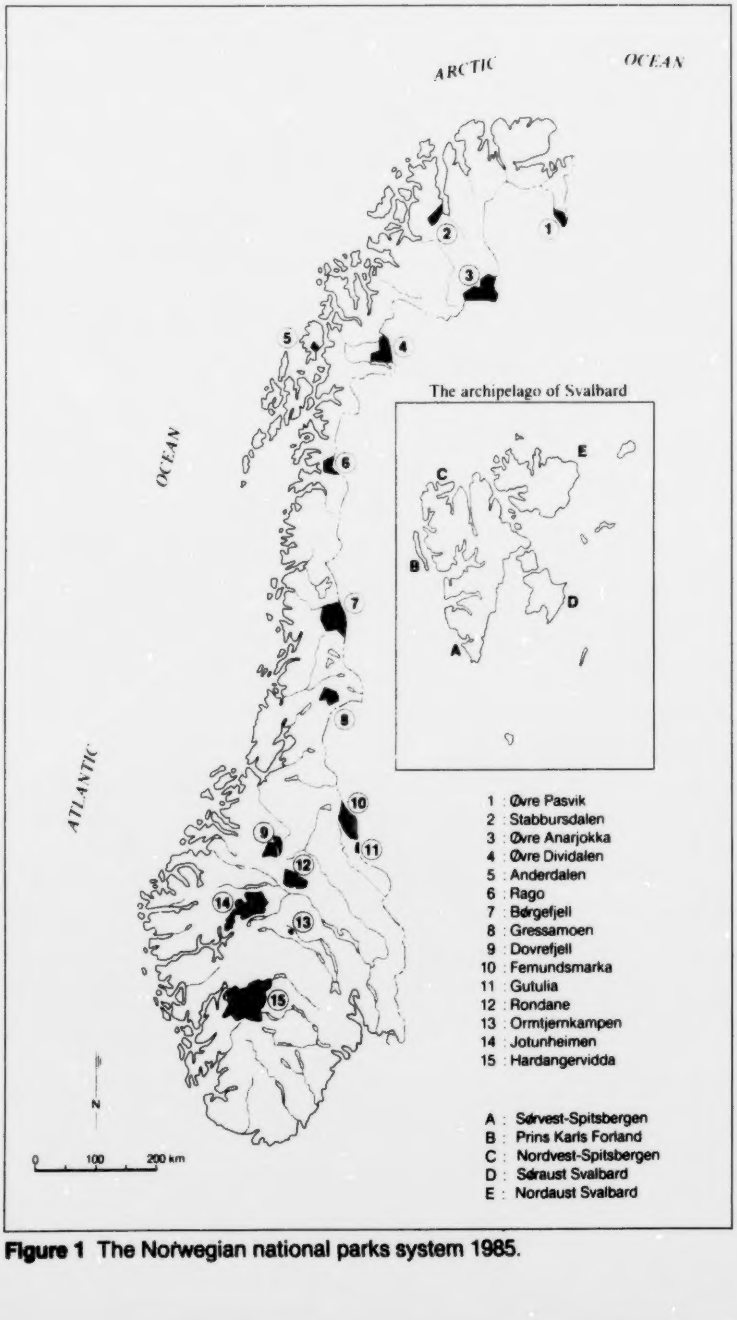

Figure 1 The Norwegian national parks system 1985.

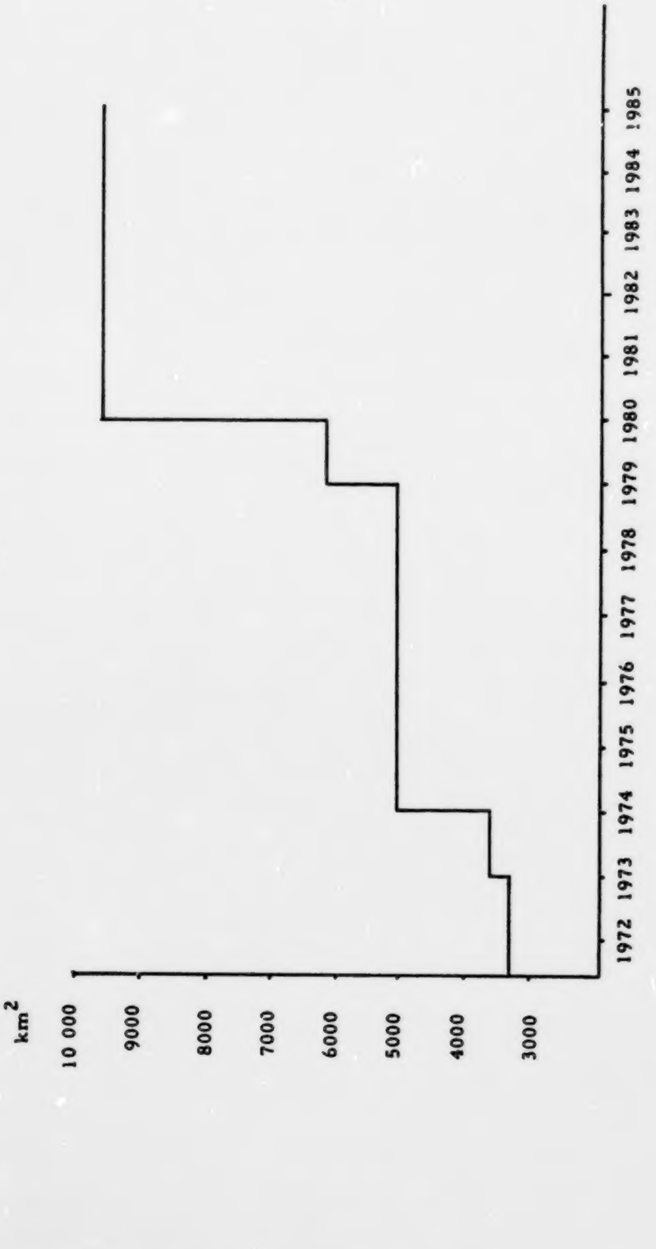

Figure 2 Developments in the national park area, 1972-1985.

Table 2 Norwegian national parks and equivalent reserves, 1985.

National park	Area (Km^2)	Established
Nordaust Svalbard*	19 030	1973
Søraust Svalbard*	6 380	1973
Sør-Spitsbergen	5 300	1973
Nordvest-Spitsbergen	3 560	1973
Hardangervidda	3 428	1981
Øvre Anarjokka	1 390	1975
Jotunheimen	1 140	1980
Børgefjell	1 087	1963
Øvre Dividal	741	1971
Prins Karls Forland	640	1973
Rondane	572	1962
Femundsmarka	386	1971
Dovrefjell	265	1974
Gressåmoen	180	1970
Rago	167	1971
Stabbursdalen	96	1970
Ånderdalen	68	1970
Øvre Pasvik	63	1970
Gutulia	19	1968
Ormtjernkampen	9	1968

*Nature reserves

National Parks in the Norwegian High Arctic

The conservation history of the Svalbard archipelago, (Figure 3) Norway's northernmost territory, is somewhat different from mainland Norway's. Nature conservation came first on the agenda at the Spitsbergen conference in Oslo in 1914. A proposal was then tabled to establish a large conservation area ("Nature park") in the northernmost corner of Spitsbergen. No decision, however, was taken. For many years after the Norwegian Conservation Society tried in vain to promote the idea of a Norwegian conservation area in the high Arctic. Results were rather meager. In the 1960s, interest in nature conservation in Svalbard increased slowly, partly due to increasing expedition and tourist activities in the area, partly because the Norwegian Polar Research Institute added biology and biological research to its fields of activities. In 1966, the first "Study of present problems related to conservation and wildlife management in Svalbard" was completed. Soon after (1967) an interministry task force was organized to prepare proposals for practical conservation measures. In 1968 the task force started to work on a draft plan for the establishment of national parks and nature reserves in Svalbard. This initiative came in due time, because oil exploration had then started in Svalbard. In perspective, the conflict between oil exploration interests and nature conservation in Svalbard was quite useful. The conflict became apparent to everyone because it raised serious legal and international questions related to the interpretation of various articles in the Svalbard Treaty of 1920. Articles 3 and 8 of this treaty outline the rights of citizens of the contracting parties to carry out commercial and economic operations. The same treaty underlines, however, (Article 2) Norway's responsibility with regard to nature conservation in Svalbard.

At the beginning of 1973, a total of 1259 oil claims had been issued to various companies. Of these, 668 claims were located within areas of high conservation value. After a rather hard and complicated battle, Norwegian conservationists probably won their most important battle ever, when the government on 1 June 1973 decided to establish three national parks, two large nature reserves and fifteen bird sanctuaries in Svalbard, covering 56.3 per cent of the total land area.

Sorspitsbergen National Park

Sorspitsbergen National Parks covers 4673 square kilometres and includes the southernmost part of Spitsbergen, the largest of the Svalbard islands. About 65 per cent of the area is covered by glaciers or areas under permanent snow and ice cover. This national park includes a great variety of Arctic landscapes, among them Hornsund, the southernmost of the large fjords.

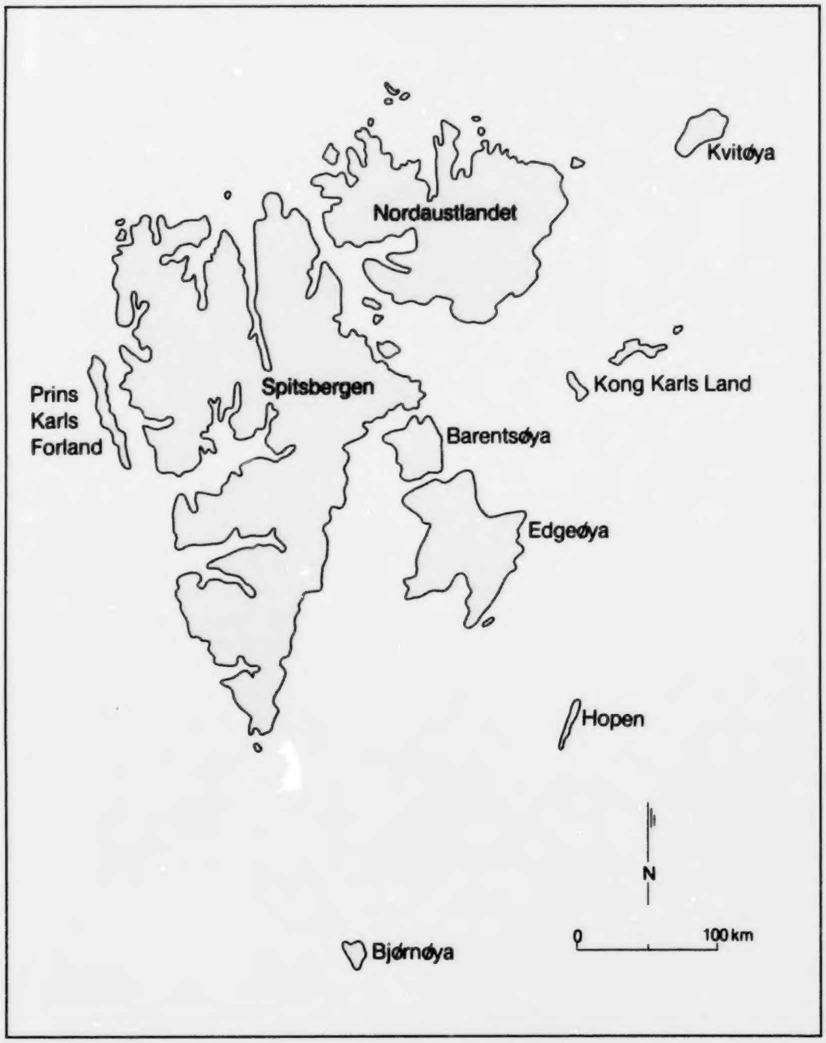

Figure 3 The archipelago of Svalbard, the high Arctic part of Norway.

Bird life is very rich and the park includes numerous seabird colonies (important breeding sites for Fulmar (*Fulmarus glacialis*), Kittiwake (*Rissa tridactyla*), Brunnich's guillemot (*Uria lomvia*) and Little auk (*Alle alle*)), and important breeding areas (smaller islands) for Eider duck (*Somateria mollissima*), Barnacle geese (*Branta leucopsis*) and Brent goose (*Branta bernicla hrota*).

Prins Karls Forland National Park

Prins Karls Forland National Park is the smallest of the three parks established in 1973, totalling 640 square kilometres. The park includes a long island outside the west coast of Spitsbergen. Its landscape is varied, including coastal plains, impressive mountains and a number of smaller glaciers. The park has important breeding founds for Fiders and all three species of Svalbard geese (the two *Branta* species and the Pinkfooted goose (*Anser brachyrhynchus*)). In this national park is the world's northernmost breeding ground for Common guillemot (*Uria aalge*) and the world's northernmost population of Harbour seal (*Phoca vitulina*).

Nordvest-Spitsbergen National Park

Nordvest-Spitsbergen National Park includes the northwestern corner of Spitsbergen and a number of smaller islands. The total land area is 3283 square kilometres. Seabird colonies are numerous within the park. Mammals include a population of the Svalbard reindeer (*Rangifer tarandus platyrhynchus*) and a small, but important population of walrus (*Odobenus rosmarus*) now recovering from the brink of extinction. This park also includes sites of significant cultural value including the remains of the famous Dutch whaling community of 1600 AD, Smeerenburg, and the point of departure of Andree's tragic expedition to the North Pole in 1897.

Nature Reserves

In addition to the three national parks two large nature reserves were also established in 1973. These two reserves cover most of the eastern parts of the archipelago. From a scientific and conservation point of view, these reserves are probably the most important of the established conservation areas in Svalbard, covering nearly undisturbed, high Arctic ecosystems. The northern parts of Nordaust Svalbard nature reserve are close to 81° N.

Nordaust Svalbard Nature Reserve

Nordaust Svalbard Nature Reserve is the largest of the conservation areas in Svalbard (19030 square kilometres). This reserve has also been nominated by Norway for inclusion in the MAB Biosphere reserve system. Within this reserve lives the world's northernmost population of reindeer.

Soraust-Svalbard Nature Reserve

Soraust-Svalbard Nature Reserve totals 6450 square kilometres and includes two large islands (Edgeoya and Barentsoya) and a large number of smaller islets. A population of 1500-2000 Svalbard reindeer lives within this reserve, where Polar bears also are numerous during the winter. Some of the most important breeding habitats for the Light-bellied brent goose are also located in this reserve.

In total, these five conservation areas cover 34,910 square kilometres of a total land area of 62,158 square kilometres. Although some smaller areas of high conservation value outside the national parks and nature reserves still deserve better protection, the existing conservation areas cover most of the ecologically important parts of Svalbard. For the future, wise management of existing conservation areas should accordingly be given higher priority than the establishment of additional conservation areas. This is important for a number of reasons:

- Since a modern airport was opened in Svalbard in 1975, an increasing number of tourists and expeditions visit the archipelago every summer.

- So far, the conservation areas have not been easily accessible for visitors. Development of local transport facilities may, however, easily lead to increasing pressure on vulnerable areas in the most critical periods of the year.

- Due to logistical problems the local conservation authority under the Governor of Svalbard has a difficult task in ensuring that existing regulations are followed by visitors. The governor's administration is furthermore not properly manned to ensure full supervision.

National Parks and Equivalent Reserves in Norway Compared with the Other Nordic Countries

Compared with the other Nordic countries (except Denmark, where the establishment of national parks is not relevant) the Norwegian national parks program was initiated very late. Yet its present system is comparable in size and number to the protected area system in neighbouring countries. Sweden began the establishment of national parks in 1909, more than 50 years before the first national park was established in Norway (1962). Most national parks in the Nordic countries were established after 1945 (Figure 4). By the mid-1980s, rather extensive national park systems exist in four of the five Nordic countries (Table 3).

In addition, a considerable number of nature reserves have been established in all of the Nordic countries. In Iceland, for example, 28 nature reserves covering nearly 7000 square kilometres must be added to the three national parks to give a more correct impression of their protected areas system. It should be stressed that national park programs cover only 0.7-3.0 per cent of the total land area in these countries, indicating that a considerable amount of conservation work remains before Norway (and the other Nordic countries) have established a representative and reasonably large system of national parks and equivalent reserves.

Perspectives on the Future

The establishment of the present national park system in Norway in its present form was completed in only nineteen years (1962-1981). The history of the national park system in the Norwegian part of the high Arctic is even shorter, since actual planning started in 1966 and implementation took place in 1973. In Svalbard, the present system of national parks and equivalent reserves is probably now complete, since existing reserves cover more that 50 per cent of the land area and most of the ecologically important regions. On mainland Norway the situation is far less satisfactory, since most of these parks are located on state land in the mountain regions. This restriction is in accordance with the Nature Conservation Act of 1970, which underlines that national parks have to be established on state land – which lies mainly in the mountains. It is evident that this is a rather serious restriction, if the present network of national parks in Norway is to be developed into a more complete, representative and future-oriented national park system.

In 1980, a government-appointed committee led by the President of the Norwegian Parliament, completed a report on national conservation perspectives in Norway. The report was in part inspired by the World Conservation Strategy, and provided the basis for subsequent report presented to the Parliament in 1981, containing a proposal for a national conservation policy plan. One of the recommendations in the 1980 report pointed out the need for a new national park policy study. During the parliamentary debate in 1981 on the report, the policy outlined therein received wide political support. On this basis the Ministry of Environment asked the National Council for Nature Conservation in 1981 to organize a study of future national park needs. From a conservationist's point of view, this study is rather important since it is realized that this is probably the last

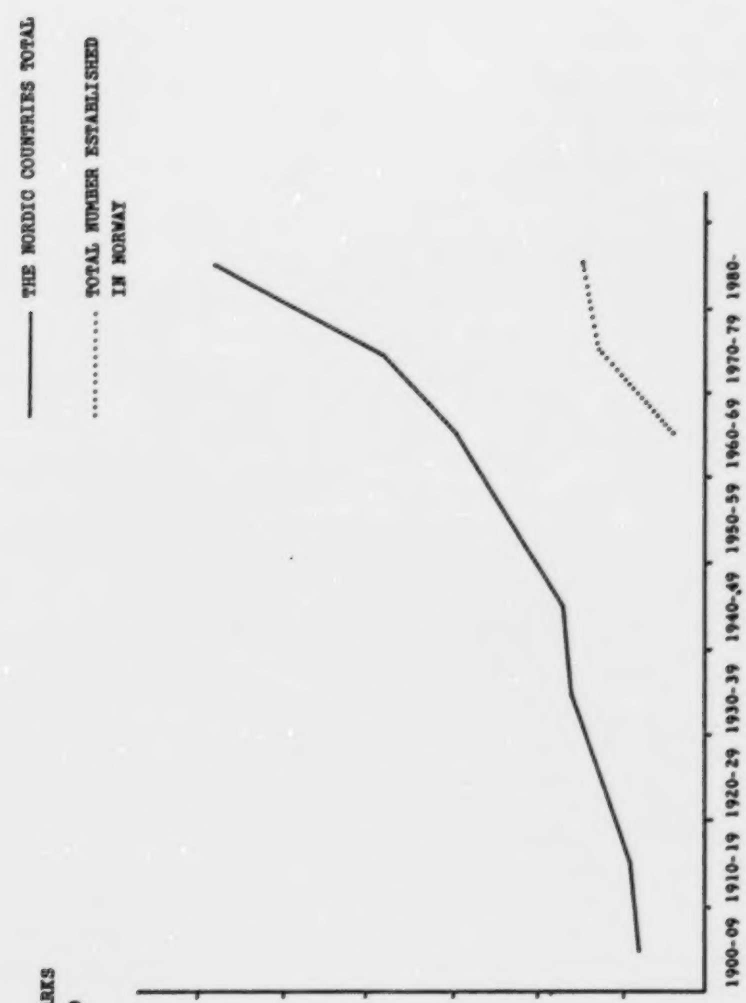

Figure 4 Trends in the establishment of national parks in the Nordic countries 1900-1985.

Table 3 Status of the Norwegian national parks system compared with the other Nordic countries, 1983.

Country	Number of national parks 1983	Total land area (km²)	Percentage of total land area within the national parks system
Denmark*	–	–	–
Finland	22	6529	1.94
Iceland	3	693	0.67
Norway**	15	9613	2.97
Sweden	18	6155	1.37
Total	**58**	**22990**	

* Excluding Greenland (where one national park, covering 700 000 km², has been established).

** Excluding Svalbard, where 3 national parks and 2 equivalent reserves, totalling 34 910 km² have been established.

opportunity for a full and extensive discussion about the establishment of national parks in Norway. Two important elements form the basis for this study:

- A critical review of the representativity of existing parks in relation to the biogeographic zonation of Norway.
- A careful review of areas of potential interest for the establishment of new national parks or equivalent reserves.

In this connection it has been decided by the Council to prepare the review on a scientific/conservation oriented basis, independent of the legal restrictions contained in the Nature Conservation Act.

Based on this review, the Council will later present its findings and recommendations. It is, however, already evident that the most serious shortcomings of the Norwegian national park system are related to the coastal areas (in general) and the lowland regions of southern Norway. Between 40 and 50 potential areas are at present (May 1985) under consideration. Although final conclusions have not yet been made, it seems reasonable to conclude from the present material that a fairly complete system of national parks and equivalent reserves in Norway will imply an extension in size of the present system of more than 100 per cent. In general terms, such a system would cover at least 6 per cent of the total land area. The legal, political and practical obstacles are, however, numerous. Most probably, conservation measures additional to the national park concept will also have to be considered. When the report is presented to the Ministry of Environment, its conclusions and recommendations will clearly represent one of the greatest challenges to nature conservation in Norway for the remaining part of this century. Only time will tell if this challenge to nature conservation actually will be met. The opportunities are still there, but in a few years they will have gone forever.

National Parks (Zapovedniks) and other Protected Areas in the Soviet Arctic and Prospects for their Development

I.A. Gaava
S.M. Uspenski
Y.P. Yazan[1]

The Soviet Arctic is experiencing the impacts of active resources development. This northern development is related to activities in such modern industries as energy (hydro, natural gas, oil), mining and transportation. In addition, anthropogenic impacts on arctic ecosystems and their components are also related to human activities and practices conducted outside of the Arctic. For example, the use of chlororganic compounds to control pests in agricultural and forest industries has contributed to the long range transport of chemical residues to the high latitudes by air and water media. A variety of human stresses has affected the migration routes and wintering areas of arctic animals. Perhaps the most important of these stresses are associated with resource development, petrochemical pollution of sea waters, and the growth of hunting.

It is in the context of these impacts and stresses that the instability and extreme vulnerability of arctic ecosystems manifest themselves most vividly. It is necessary, therefore, to implement special measures to protect these environments. Measures directed at both the *regulation* of anthropogenic factors impacting arctic ecosystems and the *organization* of a system of national parks, wildlife refuges and other protected areas deserve special attention. It is the opinion of the authors that the most effective form of nature conservation and protection in the Arctic is the park or refuge. As the Soviet Arctic still contains large natural areas that have not been significantly changed by man, such an institution can be made sensitive to both anthropogenic impacts and the necessity of protecting as yet unaffected natural environmental complexes.

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[1] Editor's Note: Unfortunately none of the Soviet authors could be present at the symposium; we are however very grateful to have their paper.

In the context of the latter, of special importance to the USSR is the protection of rare species of Arctic fauna and flora, particularly those types identified as endangered in the 1984 Red Data Books of the International Union for Conservation of Nature and Natural Resources (IUCN) for the USSR. It is important to note that 8 of 94 (8.5 per cent) mammalian species and subspecies and 10 of 80 (12.5 per cent), avian species mainly or exclusively inhabit the Arctic.

One of the most endangered mammals is the Greenlandic whale (*Balaena Mysticleus* L.), which inhabits the whole of the Chukchi and Bering Seas. Recently, a small herd was discovered north of the Barents Sea. In the same endangered category are the Siberian, Arctic or Asiatic White Crane (*Grus leucogeranus* Pall), the red breasted goose (*Branta ruficollis* Pall), and the gyrfalcon (*Falco rusticolus* L.). The two former animals are endemics of the North of Siberia. Rare species in need of protection include the polar bear (*Ursus maritimus* Phipps), the Atlantic and Laptevski subspecies of walrus (*Odobenus rosmarus orsmarus* L., *O.r. laptevi* and *O.r.tchaski*), the peregrine falcon (*Falco peregrinus* Tunst), the tundra crane (*Cygnus bewickii* Yarrell), the emperor goose (*Anser canagicus* Sewast), the barnacle goose (*Branta leucopsis* Becht), and the spoonbilled sandpiper (*Eurynorhynchus pygmeus* L.). Two animals considered endemic to the North of Eastern Siberia, the Ross' gull (*Rhodostithia rosea* MacGillivory) and the Novaya Zembla subspecies of reindeer (*Rangifer tarandus* Lyd.) are identified as restored in the 1984 USSR Red Data Book. In addition, in this same volume, two species previously considered extremely rare are also identified as restored. They are the narwhal (*Monodon monocaros*) and the ivory gull (*Pagophila eburnea* Phipps).

The recognized necessity of treating nature and its resources with consideration is well illustrated by the traditional forms of resources use practised by the Nenets, Chukchi and other peoples in the USSR's extreme north. In ancient times, these peoples established rather unique refuges. The Nenets, for example, considered *sacred* or worthy of protection Belii Island in the north of Western Siberia. Reindeer were not allowed to graze in some areas and hunting was prohibited in others. Yet, further to the south in the Yamal Peninsula, the Nanets successfully hunted caribou (*Rangifer tarandus*), arctic fox (*Alopex Lagopus*), waterfowl and other animals.

There are many other *sacred* hills, rivers and capes associated with the Nenets in the European tundra of the USSR and Western Siberia. It is evident that many preserved forest islands and much animal abundance in the tundra region are in existence today because of these early efforts of the Nenets. It is also known that at the beginning of this century, the population of the Chukchi Peninsula attempted to protect the coastal breeding grounds of the walrus.

Protected areas have also been established for other reasons. For example, Tsar Aleksei Michailovitch, in the mid seventeenth century, declared seven islands near the Kola Peninsula coast the Tsar's Reserve, as they were associated with the nesting of gryfalcons. Today, gyrfalcons are protected as are all other natural resources in this region known as the Semiostrovski area of the Kandalaksha state nature reserve.

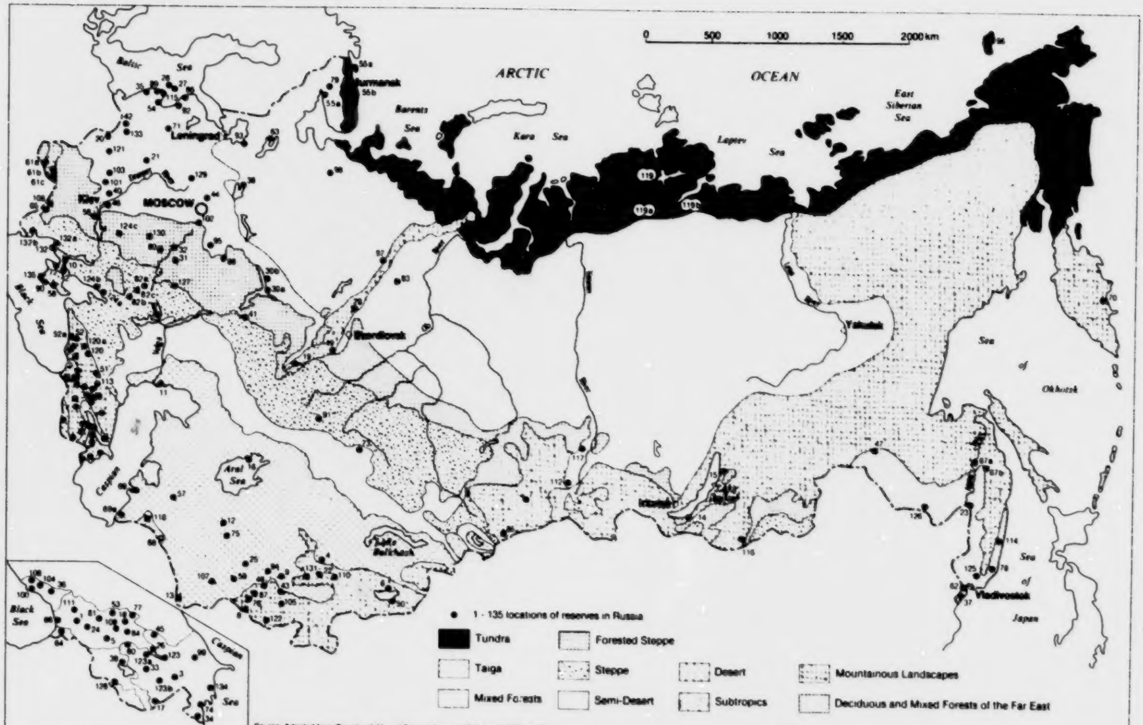
In the USSR, park establishment is considered one of the most important and effective means of promoting nature conservation. Concomitantly, it is a means of supporting scientific research on natural processes and systems. ***Parks*** are permanent institutions and economic/extractive activity is not permitted. ***Refuges***, on the other hand, are usually set aside for a specified period of time and specific plant and/or animal species are designated for protection. By the beginning of 1984, several national parks, several hundred refuges, numerous nature monuments, many protected forests, and some 140 other park and reserve-hunting units were established in the USSR.

The network of parks, refuges and other protected areas in the southern USSR was primarily established in the 1930s and improvements and additions have been made over the last 50 years. In the extreme North, where natural resource exploration and development started much later, the park and refuge network is in various stages of planning, implementation and organization.

At the present time, Laplandski, Kandalakshskii and Taymyr parks and Wrangel Island refuge are established in the North (Figure 1).

Laplandskii Park is situated in the Murmanskaya region of the Kola Peninsula. It was set aside in 1930 and was originally 160 thousand hectares in size. In 1983, its area was considerably enlarged. The park is composed of mountain tundra, forest and lake regions. The largest and most well known water body is Chun Lake. Park fauna is typical of mountain tundra and European taiga. Recently, much management attention has been focussed on the protection of local caribou herds, as they have been valuable research subjects.

Kandalakshskii Park was established in 1939, and is also found in the Murmanskaya region of the extreme northwestern USSR. It is a complex of islands and mainland areas. More specifically, it unites five island groups in the Belii (White) and Barents Seas and three mainland areas. There are approximately 500 islands in these groups, including the Inovi chain, and the park has a total area of 58 thousand hectares. Different tundra types are represented in the park. Colonies of the ***Alcidae*** family (auklets, murres, guillemonts), the ***Laridae*** family (gulls, terns, cormonants) and the nesting grounds of the Common eider (***Somateria Mollissima*** L.) are found here. Plots of typical European taiga are also in evidence on park islands in the White Sea.



Source: Adapted from Borodin, A.M. and Syroyechkovskiy, E.E. (eds.) 1983: 16-17

Figure 1 Map of landscape zones and the distribution of zapovedniks, reserve-hunting/wildlife management units, and reserve-forestry/wildlife management units of the USSR.

Taymyr Park occupies the central part of the Yarmyr Peninsula and covers part of the Yarmyr national district of Krasnoyarskii region. It was established in 1979 and includes 1.3 million hectares. Typical arctic and subarctic tundras are represented and the most northern of the Eurasia forest islands, situated in the lower reaches of the Hatanga River at about 70 degrees north latitude, are also included. The main scientific and research curiosities are the nesting grounds of red-breasted geese (*Branta ruficollis*) and large herds of caribou.

Wrangel Island refuge is situated at the junction of the East Siberia and Chukchi Seas and includes both Wrangel and Herald Islands. It embraces part of the Chukchi national district of Magadan region, and was established in 1975. Its 800,000 hectares of Arctic tundra include both plain and alpine environments. Wrangel Island Refuge is extremely important because it protects the largest denning/breeding area for polar bear in the Soviet Arctic. It is calculated that 200 females den in this region and that 2300 cubs are born annually. In addition, the refuge includes the only large Soviet Arctic nesting ground of the snow goose (*Chen caerulescens* L.), one of the world's largest coastal walrus rookeries, and a large herd of introduced musk-oxen (*Ovibos moschatus*).

In addition to the above-mentioned parks, there are approximately 20 hunting refuges in the extreme north. The largest of these, some 1.5 million hectares, is in Western Siberia and is located near the Yamal and Grydan peninsulas. It was established to protect waterfowl nesting and moulting areas. The Chaigurino refuge, another unit of some 1 million hectares, is in the Kolima region of Eastern Siberia and was established to protect the nesting grounds of the Asiatic White Cranes (*Grus leucogeranus* Pall) Ross' Gull and other waterfowl.

Many factors, influences and decisions have contributed to the enlargement of the protected areas network in the USSR. For example, there exists a special *Order of the Presidium of the Supreme Soviet of the USSR.* This precept has as its theme "the Strengthening of Nature Conservation in the North". It envisages the establishment of a comprehensive network of protected aquatories and territories. The formulation of the scientific rationale for such an institution is the task of all the All-Union Institute on Nature Conservation and National Parks of the Ministry of Agriculture of the USSR.

In the context of the scientific value of an Arctic park network and preserve system, Uspenski (1969 and 1983) and others have studied and reported upon the richness of marine and coastal environment life, and particularly bird populations. As one moves northwards, the number of bird species closely associated with and dependent upon the water environment increases and ducks (*Anseriformes Anatidae*), guillemots (*Charadriiformes Laridae*), gulls (*Charadriiformes Laridae*) and snipes (*Charadriiformes Scolopacidae*) dominate. In the high latitudes of the Arctic even the few terrestrial birds and mammals begin to lead a semi-marine way of life. The ecological soundness of any arctic preserve system demands that the necessary high latitude aquatories of arctic polynyas be included and that the zonal specificity of arctic ecosystems be recognized.

In this discussion it must be remembered that extreme arctic climatic and environmental conditions produce successions that are vulnerable and different in stage from those in the southern tier of the USSR. For example, one of the determining factors of successional change - the temperature gradient of the water regime - is limited by the deficiency of warmth in the form of a restricted temperature range and the surplus of moisture. As a result, succession is retarded and natural complexes remain in an unchanged state for a long period of time. Further, ecologically developed successional stages in polar watershed habitats occupy no more that 3 per cent of total area for developed successional stages in temperate climatic regions. The lesson to be learned in this context is an important one: that is, the size of protected arctic territories must be larger that those in the temperate south. Theoretical calculations and world-wide experience suggest that arctic protected areas may be ecologically autonomous if they are not less than 0.5-1.0 million hectares in area.

The creation of a protected natural territories and aquatories system must be based on the principles generally adopted in the USSR and, in particular, the landscape-zonal principle. In the process of identifying those arctic land and seascapes to be reserved, certain ecological indicators are used. Are the land and seascapes *typical*? Do they contain *representative* natural complexes? Do they include a degree of *uniqueness*?

One of the most promising candidate reserve regions on the Soviet Arctic is Franz-Joseph Land. Not only does it exhibit the ecological indicators previously identified, but it also contains a rich historical record and abounds in historical artifacts and potential monument sites. Preliminary planning studies suggest that the protected area in Franz-Joseph Land should be approximately 4 million hectares, of which 1 million hectares would be land regime, 1 million hectares polynyas, and the remaining 2 million hectares in other marine regimes.

In Franz-Joseph Land sea torrents and permanent polynyas result in the interpenetration of land and marine elements. Glaciers and fresh ice account for more that 80 per cent of thes surface of the islands. Typical varieties of arctic vegetation are represented and within the associated archipelago 37 bird species are found. In addition, fourteen of these species regularly nest here and the largest ivory gull nesting ground in the USSR is also present. Nine mammalian species including polar bears have dens in the area. However, mammals are best represented by flippers, whales and walruses. Narwhals are quite common and Greenlandic whales have been observed at various coastal locations.

A similar ecological stature is associated with the Sibirskaya polynya and surrounding area. This region includes a considerable part of the Eastern-Siberian Sea and such adjacent land areas as the Lena River Delta, the Eastern Coast of the Taimyr Peninsula nd some of the Severnaya Zemlya and Novosibirskie Islands.

Eventually the protected natural territories and aquatories system of the Soviet Arctic will also include new parks in the European tundra, and Western and Eastern Siberia. In addition, new national parks and refuges will be established on the most picturesque landscapes and within the greenbelts surrounding large human settlements.

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Postscript
The authors would like to thank Dr. Roger Needham, Department of Geography, University of Ottawa, for re-writing and editing this paper.

Editor's Note:
Paul Grigoriew did appreciable work in clarifying scientific and lay nomenclature re: the bird references in this paper.

Commentary on National Parks and Protected Areas in the Arctic: National Overview

William Barr

Introduction

This afternoon we have heard a stimulating series of presentations, focussing on how five of the seven circumpolar arctic nations have dealt, and are dealing with the problems of conservation of arctic landscapes and environments. I have learned a great deal from the presentations – more from some than from others – but in every case there are still questions in my mind. On behalf of the audience I should like to raise these questions in the hope that either this afternoon, or in the final written form of their presentation, the authors may be able to resolve some of them.

Boundary of the Arctic

In only one case, that of the Canadian Arctic, was the southern boundary of the area in question specified. If you recall, at the outset of his presentation Mr. Gordon Hamre specified that he would deal with the area north of the treeline as representing Canada's Arctic. None of the other speakers provided any information as to where they considered the southern boundary of the Arctic to lie.

For discussion purposes I too have assumed that the treeline represents the southern boundary of the Arctic, although I am only too well aware of the considerable divergence of opinion among ecologists and biogeographers as to what the treeline is and where it lies.

In his paper Mr. Tom Kovacs selected the political boundaries of the Yukon and Northwest Territories as delimiting the Canadian Arctic. As I am sure you are all aware there is enormous divergence between the treeline and the 60th parallel across the width of Canada. In the Western Arctic the treeline almost reaches the 70th parallel in the lower valley of the Horton River. This means, of course that some parts of Mr. Kovacs' presentation are not strictly relevant to this symposium's deliberations. For example all references to Kluane, Nahanni and Wood Buffalo National Parks would fall in this category.

By the same token there are substantial tundra areas which lie outside the Northwest Territories and the Yukon. Here I am thinking particularly of Nouveau Quebec and Labrador. It is perhaps relevant to note that the largest caribou herd in North America spends part of the year in this latter part of the Arctic. Having said this, I recognize that Mr. Kovacs' choice of boundary is dictated by administrative convenience and availability of statistical data.

Moving eastwards, I do not think that anyone would dispute the statement that Greenland lies entirely in the Arctic. Clearly therefore everything Morton Melgaard said is relevant to the context of this symposium. In the case of Magnar Norderhaug's presentation I was left in some doubt as to where he believes the boundary of the Arctic to lie. He defines Svalbard as lying in Norway's "High Arctic". One might entertain the idea however, that several of the fifteen national parks on the Norwegian mainland also lie within the Arctic. Six of them lie north of the Arctic Circle and I suspect that several of them consist partly or even mainly of tundra.

In the case of the Soviet presentation an attempt was made to select only the most northerly of the conservation units in what the Soviets generally consider as the North. If, however, one uses the criterion of the treeline, it is clear that the Laplandskiy zapovednik does not lie within the scope of this symposium; it is largely covered by boreal forest or *tayga*, although there are some mountain tundra zones. The Kandalakshskiy zapovednik not only straddles two political/administrative units, but it also straddles the treeline. The islands in Kandalakshaya Guba (the western arm of the White Sea) lie south of the treeline; the Seven Islands and other island groups off the Murman coast (also within the zapovednik) lie, I believe, north of the treeline. Farther east, of course, both the Taymyrskiy zapovednik and that on Ostrov Vrangelya lie entirely north of the treeline, although it is worth noting that the Taymyrskiy zapovednik includes two forest patches of Daurian larch which are the most northerly trees in the world (72° 40'N).

In the case of Alaska I would suggest that a reasonable southern boundary of the Arctic is the treeline; this runs along the southern flanks of the Brooks Range, although it swings much farther south along the Bering Sea coast. On the basis of that boundary I am still unsure from Mr. Stenmark's remarks as to how many national parks or wildlife refuges exist in Arctic Alaska.

Definitions of Protected Areas

In several of the presentations little attempt was made to clarify the implications of what was meant by terms such as *national park* and *nature reserve*, etc. To my mind at least some of the most crucial points to be clarified here are those of public access, economic exploitation and subsistence hunting. Of the various speakers, Tom Kovacs has provided the clearest statement as to the distinctions between the different types of protected areas in terms of the Canadian context. In the case of Greenland, Henning Meyer also spelled out quite clearly the distinctions between the Northeast Greenland National Park and the various preserves elsewhere in Greenland. In the case of the Norwegian situation I was left in some doubt as to the implications of the Svalbard nature reserves. I gained the impression that the public has access to these, but some further clarification would be useful.

In this regard Mr. Stenmark's presentation was particularly instructive in that he spelled out the situation very clearly concerning the various conservation units, whether in terms of sport hunting, subsistence hunting or mining. In the latter case he brought us right up to date with the forty-one mining operations still occurring in Alaska parklands in 1985.

The least clear presentation in this regard was that of our Soviet colleagues. My understanding is that a zapovednik is an area withdrawn from all economic exploitation, *including tourism*, and set aside for scientific and educational purposes. Government regulations passed by Gosplan on 27 April 1981 specify that zapovedniki "are established with the aim of preserving in a natural state typical or unique areas (natural complexes) within a given landscape zone, with their full totality of components, for the study under natural conditions of environmental processes and phenomena, and for the establishment of scientific bases for the conservation of nature" (Syroyechkovskiy and Shtil'mark, 1983). My impression is that the general public does not have access to zapovedniki. If the general public is indeed excluded this is an extremely important distinction to bear in mind when attempting any comparison with national parks elsewhere.

I assume that in referring to "hunting refuges" Gaava *et al.* have in mind the protected areas referred to in Russian as zakazniki. To quote from the 1981 Gosplan resolution once again, these "are established with the aim of preserving, increasing and restoring individual, or a limited number of, components of the environment, and of maintaining the overall ecological balance, but their establishment does not involve the withdrawal of the land areas they occupy from commercial exploitation" (Syroyechkovskiy and Shtil'mark, 1983). In other words a zakaznik may focus on a particular species such as the eider duck or wild reindeer, but it does not exclude mining or oil exploration within the boundaries of the zakaznik.

In terms of future developments in the Soviet Arctic I understand that two further types of conservation areas are being contemplated. One is the biosphere reserve (biosferniy zapovednik) and the other is the natural national park (prirodniy natsional'nyy park). Could we perhaps hear what is implied by these two categories, especially with regard to public access and economic exploitation, and as to which areas of the Arctic may be so designated in the future.

People

On a different topic, it is well known that the concepts of environmental protection and of public access are sometimes very difficult to reconcile within the framework of a national park. I am reminded of the recent exchange of correspondence in *Information North* (1984), concerning an English botanist, Dr. Peach, who, having encountered a blonde-coloured grizzly while hunting for an elusive saxifrage in Kluane National Park, roundly and publicly berated Parks Canada for allowing such dangerous animals to wander freely in a national park. While I realize that this is a very complex and controversial issue, and could probably form the basis of a separate symposium, I was surprised that very little has been said by any of the speakers about visitor use of arctic national parks, and provision of visitor facilities. Perhaps even more importantly, almost nothing was said about employment of local people in the parks and about their various multiplier effects.

I am sure that statistics on visitor use and on employment must be readily available in almost all the countries concerned, and some discussion of this topic would certainly enhance the various presentations. Naturally, since tourism is prohibited in Soviet zapovedniki, the remarks on visitor use would not apply, but some information on local employment would be very useful.

In the Alaskan case so many of the parks and conservation units are so recent that the data can scarcely be expected to be available yet. Nonetheless Mr. Stenmark gave us some indication of general trends.

Problems

In Canada, at the present day, establishment of a national park anywhere in the country, but especially in the Arctic, is a long, slow and painful process of negotiation and compromise between the interested parties, the most conspicuous of these being the indigenous people's organizations, the mining and oil-and-gas interests, the conservationists and the various levels of government. I am sure Mr. Kovacs will attest to this. Having been involved, as a consultant working for Parks Canada in the early stages of the planning process, I am well aware of the complexity of the problems. I feel that Mr. Kovacs has given us a particularly frank and open overview of how these types of negotiations are pursued and how the role of such negotiations have varied over time.

With regard to Alaska, Mr. Stenmark treated us to an exhaustive presentation on the tortuous political processes involved in the establishment of parks and other conservation units, and gave us at least some idea of the intricacy of management problems.

In the case of Greenland and Norway, too, we have been provided with a reasonably clear, detailed insight into the social and political processes and the historical sequence of events which have given rise to their present systems of national parks and protected areas. As elsewhere, the process has not been without rough patches. In the Soviet case, in particular, conservationists have had to cope with a wide array of daunting problems which generally eclipse those which other nations have had to confront.

I shall cite only a few examples. Gaava *et al.* informed us that the Laplandskiy zapovednik was set up in 1930 with an initial area of 160,000 hectares. Despite the fact that zapovedniki theoretically are established in perpetuity, this zapovednik was in fact abolished in 1951; worse still, commercial logging occurred within the area of the zapovednik from then until 1960 when it was reinstated initially as part of the Kandalakshskiy zapovednik. But this is not the only disaster which the Laplandskiy zapovednik has managed to survive. In recent years the forests in the eastern part of the park have suffered severely from atmospheric pollution from the smelters at Monchegorsk (Syroyechkovskiy and Shtil'mark, 1983). The expansion of the park in 1983, described by Gaava *et al.*, was in part to remedy the damaging effects of air pollution by incorporating substantial areas of unaffected forest within the park boundary.

While one might have wished that our Soviet colleagues had brought some of these problems to the fore in their presentation, one can assure them that they are not alone in having to cope with threats to existing national parks. In Canada one can think of the threat which the recent proposal for a dam on the Slave River posed to Wood Buffalo National Park. And also in Canada one can cite at least one case of a national park which was eliminated in response to economic pressures: in the mid-1920s Alberta's Buffalo National Park near Wainwright was closed and over the period 1925-28 some 6500 plains bison which had previously lived there were transported north to Wood Buffalo National Park. In the light of experiences such as these one becomes only too well aware of the need for vigilance to ensure that established parks and conservation areas, in whatever country, are not encroached upon.

Summation

I feel that we have been privileged to hear an excellent series of presentations covering the scope and history of development of natural parks and other protected areas in the Arctic. There are, however, four main areas where, in some cases, I would like to see further explanation and clarification. First a more rigorous statement as to the boundaries of the Arctic would be useful. Secondly, a clear statement from each country as to what exactly is meant by the various terms for categories of protected areas generally in use is essential. Without this, comparison from one part of the Arctic to another becomes a futile exercise. Thirdly, I would have liked to hear more about public access, visitor use and employment of local people. And finally, one would hope that future gatherings of this type will focus on current and potential future threats to the continued existence and operation of existing national parks and conservation areas.

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Critique on National Parks and Protected Areas In The Arctic: National Overviews

Hal Mills

Introduction

The "National Overviews" papers in the session are an example of why it may not be a good idea to ask government officials to evaluate their own programs. In short, the papers are lacking in critical analysis.

The authors have done a commendable job of documenting the national parks and protected areas system in their countries, the historical development of the system, the legislative basis, and the present policy directions. The papers contain a wealth of interesting information on parks and protected areas in the circumpolar Arctic.

But what are we to make of the descriptive information? Does the circumpolar system of parks and protected areas do a good job of conserving our Arctic heritage resources? How does the system in any one country stack up against the system in another country? Are there lessons to be learned from the USSR that might be of assistance to other circumpolar nations? Is it sufficient to have "national" park and protected areas systems, or should we be looking at international requirements? The papers seldom even raise the questions let alone attempt to provide any answers. Even for their own countries the authors provide little information that could be used to evaluate the effectiveness of their parks and protected areas for conserving heritage resources, and they provide no basis whatsoever for comparison from one country to another.

On a minor point it is surprising, in view of the title of this symposium, that so many papers ignore the term "arctic" and simply provide us with national overviews. Surely all of Alaska should not be considered as "arctic."

Alaska

Stenmark does a good job of summarizing the factors which shaped the extensive park and protected area system in Alaska. The Alaska experience could prove instructive for other circumpolar nations, perhaps particularly for Canada.

Statehood (with devolution of powers), the Prudhoe Bay oilfield, and the Alaska Native Claims Settlement Act all have played important roles in shaping the present system, with a strong "made in Alaska" component. The push and pull between national, state and native interests is really the fascinating part of this story. The Alaska National Interest Lands Conservation Act (ANILCA), with its conservation system units, seems to be the vehicle for attempting to resolve many of the outstanding issues. With some 36 per cent of the land and inland water area of Alaska now in one form or another of conservation system unit, it is evident that a lot has been accomplished.

But what about the issues, especially those that show no sign of going away? Sport and subsistence hunting rights, the debate over the wilderness designation concept, the development and implementation of conservation and management plans, and access to conservation areas are issues that may remain unresolved for some time. How they are resolved could have a large impact on the future of Arctic heritage conservation in Alaska.

Hunting is not seen as a threat to conservation here, unlike in most other circumpolar nations, and is provided for under the ANILCA. This is an issue of special importance to native harvesters throughout the circumpolar Arctic, and it may be necessary for we "southern conservationists" to re-evaluate our positions. If conservation can be assured through effective management practices, then native harvesting requirements should be accommodated as in Alaska. From a somewhat isolated perspective it would seem that sports hunting could be a far thornier issue for the future.

There are two important topics that are not covered in Stenmark's paper: marine conservation, and international cooperation. Marine conservation apparently gets short shrift because of legal complications between Alaska and the US regarding jurisdiction over offshore resources; a problem, but hardly a good reason for not addressing the issue. The case of the Porcupine caribou herd could have been used to illustrate the need for international cooperation for the conservation of transboundary heritage resources.

Canada

Kovacs presents considerable detail on the complexities of nature conservation in the Canadian Arctic in what is a very dynamic time for Yukon Territory and the Northwest Territories. Industrial developments, the devolution of powers from the federal government to the territorial governments, and native land claims negotiations are key elements of the profound change that is taking place. These elements both underscore the need for a comprehensive conservation strategy and create roadblocks for attempts to put one into place.

Kovacs makes the point that the size of protected areas in the Arctic must be quite large in order to protect northern ecosystems. Areas of high productivity form key ecosystem components which are few and localized, making them potentially susceptible to environmental damage. Protection and conservation of these areas should be of special importance in the consideration of a network of national parks and protected areas.

Yet reading between the lines of Kovacs' paper leaves one with the conclusion that Canada has a long way to go. Conservation actually has declined since the days of the Arctic preserves while the need for conservation has increased. Despite the existence of some national and territorial parks and various forms of sanctuaries or protected areas, and despite the Report of the Task Force on Northern Conservation, there is no comprehensive conservation strategy for the North. Many important ecological sites have no protective status. Arctic marine ecosystems are of critical importance to native people, yet they are especially vulnerable. Public support, political will, and the settlement of native claims are required in order to address Canadian Arctic conservation issues.

Greenland

Morten Meldgaard not only did a fine job presenting Henning Meyer's paper on Greenland, but added his own colourful comments and showed some fantastic slides. Meyer's paper stresses the interrelationship between the need for protection and the dependence of the small Greenlandic population on renewable resources, with traditional harvesting now supplemented by commercial fishing. This has fostered "a respectful attitude towards nature" by Greenlanders. Even prior to Home Rule (1979) the Greenlandic Council took a number of steps to regulate/protect wildlife. The Melville Bay Wildlife Reserve was set aside at the initiative of the adjacent municipal councils of Thule and Upernavik to provide a refuge for the very animals that their hunters depend upon for subsistence.

The Northeast Greenland National Park is one of the most significant in the circumpolar Arctic, covering 700,000 square kilometres. Its remoteness and lack of a local population undoubtedly will contribute to preservation of its natural condition, and it will serve as a valuable benchmark for science in the years ahead. But it is worthwhile noting that, even given its remoteness, park officials are encountering problems in supervising visitors who are being attracted to the area in increasing numbers. National parks do have the nasty habit of attracting visitors to wilderness areas.

But how does Greenland rate in the establishment of national parks and protected areas? Certainly it deserves high marks for the very large park in the Northeast, but the rest of the map only shows the Melville Bay Wildlife Reserve and a few small caribou reserves in the Southwest.

Surely there are significant areas worthy of national park or protected area status along the populated west coast of Greenland – yet Meyer does not address future requirements for the system.

USSR

The paper by Gaava, Uspenski and Yazan provides valuable and interesting insights into a system of national parks and protected areas that is fairly well developed in the southern Arctic and "in the state of organization" in the far north. The Soviets recognize national parks as an important means of nature conservation, and give particular importance to the protection of rare species of Arctic fauna and flora. Their system includes a network of parks, refuges and other forms of protected areas, many of which were established in the 1930s.

The traditional conservation practices and refuges of the Nenets and Chukchi peoples is worthy of note, with the "sacred" places still striking in their abundance of animals. It is recognized as well that the size of protected areas in the Arctic must be larger than in the south in order to protect the ecosystem. The zonal specificity of Arctic ecosystems is taken into account, and the importance of marine components is stressed in the high latitudes of the Arctic. This is most encouraging.

The information provided on the Barents Sea Park, the Wrangel Island Refuge, Franz-Joseph Land, and the Sibirskaya polynya area also is most encouraging, albeit difficult to evaluate. At the very least, it is evident that the rest of the circumpolar Arctic may have a lesson to learn from the USSR about the importance of national parks and protected areas for the Arctic marine environment. But the information provided in the paper is very difficult to evaluate, and it is indeed unfortunate that the authors could not be present to answer questions about their system.

Norway

Norderhaug's paper gives an historical summary of nature conservation in Norway and the development of the national park system. It pays particular attention to the Svalbard archipelago, and notes the usefulness of the oil-nature conflict in convincing the government of the need for national parks and protected areas. Perhaps this could be termed the "every silver lining has a cloud" syndrome.

Certainly Svalbard appears to be the jewel in the crown of nature conservation in Norway, with more than 50 per cent of the land area of the archipelago protected in three national parks and two nature reserves. This high Arctic archipelago is extremely rich in bird life, containing important seabird colonies, and also is important for its populations of reindeer, polar bears, and marine mammals. Unfortunately, Norderhaug gives scant attention to requirements for protection of the marine environment in the vicinity of Svalbard.

The "perspectives on the future" section focusses on the new national park policy study, including a review of the representivity of existing parks in relation to biogeographic zones, and a review of potential interest in establishing new parks or reserves. With speculation that this may result in a doubling in the area of the national park system, one can only hope that we will see more parks and protected areas in the coastal and marine portions of mainland Norway. Judging by Figure 1, these areas seem to be under-represented in the present system.

Conclusion

Arctic heritage interests, as reflected in national parks and protected areas, requires a form of "north-south" dialogue on wilderness concepts and conservation. We southerners are stereotyped as naive environmentalists who look on the Arctic as the last frontier of wilderness, wanting to lock it all up before it is too late. Northerners, the people who actually live in the Arctic, don't have the same concept of wilderness. They simply say that the Arctic is home, the place where they and their ancestors have lived for many years, where they are as one with nature, and where they depend on the land and renewable resources for subsistence and for maintenance of their cultural heritage. The right to hunt, to harvest renewable resources within sustainable limits, is of paramount importance to the people of the Arctic. In my opinion the onus is on southern conservationists to re-examine their concepts of wilderness and find room to accommodate harvesting rights in Arctic heritage areas.

Arctic ecosystems are not as fragile as they usually are portrayed to be, the harsh environment demands that they be just the opposite. However, the areas of high productivity are few in number and localized, and productivity is variable both temporally and spatially. This makes the key ecosystem components vulnerable to human activity and underlies the need for an effective system of park and protected areas.

Marine conservation received little mention in the national overview papers, and there is an obvious under-representation of marine areas in national park and protected area systems throughout the circumpolar Arctic. This is unfortunate as many native people living in the Arctic are dependent upon marine renewable resources. Localized areas such as ice-edges and polynyas are where productivity is concentrated, and some of them require conservation and protection of heritage resources. There also is little mention of the requirement for international cooperation in such areas as Baffin Bay where marine mammals migrate from Greenlandic to Canadian waters. At a multilateral level, the Arctic Ocean should be considered for inclusion in UNEP's Regional Seas Program.

Commentary

Jeremy Harrison [1]

I must agree with Hal Mill's comment on the low level of analysis of the existing protected areas systems in the papers we have heard this session, although I did cover this to some extent in the paper I presented yesterday. I also made a number of comments on the currently poor coverage of marine and coastal environments. It is perhaps unfortunate that neither Hal Mills nor William Barr have seen the full text of this paper.

In his presentation on Greenland, Morten Meldegard makes the rather modest comment that the Greenland National Park is the largest in the world. I should point out that at 70,000,000 hectares it is the largest by nearly an order of magnitude. In fact, in the north we have been fortunate in our ability to declare relatively large protected areas. Twenty-one of the 165 areas covered in our paper are over 1 million hectares, with 11 of the 63 areas north of the Arctic Circle covering more than 1 million hectares.

We should also note the tremendous size of other declared areas such as the Migratory Bird Sanctuaries of northern Canada. Extensive tracts of northern forests in USSR have some degree of protection. Neither are completely protected, but both make important contributions to conservation of northern environments.

Both these large areas and the smaller ones cover a wide range of biotic and geological/geomorphic features, but this coverage is patchy and needs extending. We have heard from Tom Kovacs about Parks Canada's approach to protected areas planning, and from Lars Pahlsson about landscape planning in the Nordic countries, but analysis of conservation needs clearly must be made on a continuing basis right across the region.

We still have some way to go on the establishment of conservation areas, let alone assessment and improvement of management.

Finally, let me repeat the last paragraph of the paper I presented yesterday, and say that it should be re-emphasized that protected areas should be one component of fully integrated land-use planning programs within the region, which take full account of all conflicting land-use requirements. Monitoring within protected areas and other areas should provide an input to the continual process of assessment of man's impact within this sensitive region, information which can be used in the planning process.

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[1] This commentary was made at the request of the Symposium Moderator and Session Chairman. Mr. Harrison's paper and expertise were relevant not only in the first of the land use sessions but in this national park and protected area session as well.

The previous point deserves emphasis because, perhaps in this region more than most, it must be made clear that the systems of protected areas are not areas isolated out, but part of a range of management options which must be fully applied to make the best and wisest use of available resources.

Summary of Discussion on National Parks and Protected Areas: National Overviews

Editors

This session of the Arctic Heritage Symposium was rich in spontaneous discussion and recommendations. The panel of critics was enlarged to include Jeremy Harrison of the International Union for Conservation of Nature and Natural Resources (IUCN) Protected Areas Data Unit. His circumpolar perspective and commentary supplemented participant comparisons of several overviews.

It was concluded during the course of the discussion that four important observations could be made about park and reserve system status in the circumpolar area. First, a variety of regional and national biogeographic approaches are used by circumpolar nations north of 60° Second, the nations utilize a variety of classification systems that reflect the different national objectives for protected area systems. Third, much work must be done to improve the quality and the comprehensiveness of environmental data and the sharing of information among Arctic nations. Fourth, real improvements in knowledge base, system expansion and international cooperation can only be realized with an improvement in national political will and commitment. It was felt that the academic and scientific community could be an influential lobby in this respect, perhaps through a coordinated international action plan, or through new or existing institutional arrangements, such as the Northern Science Network, IUCN, UNESCO, MAB.

The dialogue among session chairpersons, critics and participants concluded with a statement of more specific recommendations. First, a network of representative protected areas should be considered as a basic element in a comprehensive approach to land use, resource and environmental management. Protected areas are fundamental to sustainable development – through their multi-faceted contribution to tourism, recreation, plant and animal conservation, research, environmental monitoring, local economy, and other uses. Second, a concerted effort should be expended to fill in the gaps in the existing circumpolar network. Particular attention should be focussed on lakes and the coastal environment. Third, a more innovative management regime is needed in order to promote varying uses in different categories and types of protected areas. Fourth, a process of continuous monitoring of the entire circumpolar system should be developed and maintained in order to follow the environmental health of the Arctic and other parts of the world and better manage park and heritage areas. Fifth, a research strategy should be drafted which includes such priority themes as: biological inventory; the impacts of arctic tourism; the protection of marine mammals; research and environment monitoring and human ecology.

APPENDIX

Axel Heiberg Island, NWT
Courtesy: Trent University

Arctic Heritage Symposium, Banff, Alberta August 24-28,1985

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The Arctic as a Regional Sea[1]

J.Gordon Nelson
Roger D. Needham

Introduction

Many inhabitants of North America, Europe and other regions of the world, are apt to consider the Arctic region as one that has so far been little affected by the activities of Man, and as not likely to be much affected in the at-all-near future. Such a view is unfortunate, as it forestalls concern about ongoing land-use changes that can adversely affect the renewable resources and environment upon which future economic and cultural development of the world's most northerly lands and seas so widely depends.

In fact, the Arctic has been explored and used by Man for thousands of years (Valentine and Vallee, 1968; Brody, 1975; Hamelin, 1975). Such maps as those prepared by Louis Rey (1982) show how indigenous peoples have moved from northern Asia and Eurasia into the Arctic region since the terminal stages of the last continental glaciation some 25,000 years ago (Figure 1). In approximately the last four hundred years, in particular, human beings have been increasingly active in the Far North, beginning with the coming of Europeans in search of a north-west passage to China and the riches of the Orient. In 1607, one such adventurer, Henry Hudson, reached the islands of Spitsbergen (Svalbard) where, among other things, he found whales playing in the fjords like "carp in a pond" (Rey, 1982). News of the bounty soon brought hundreds of ships to northern seas, beginning competition over whaling grounds that lasted until serious depletion of the animals was evident by about 1910.

Subsequently gold-seekers, furtraders, hard-rock miners, and military personnel, all brought stresses on the arctic environment (Zaslow, 1971, 1981; Wonders, 1976, 1981). Muskox (*Ovibos moschatus*), caribou (*Rangifer* spp.), and other animal populations, were depleted. Many if not most of the native peoples were decimated by disease. Conservation measures were introduced, notably after 1900. In Canada, these included

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[1] Reprinted from *Environmental Conservation*, Vol. 12, No. I, 1985, pp. 7-15. With kind permission of the editor, Nicholas Polunin.

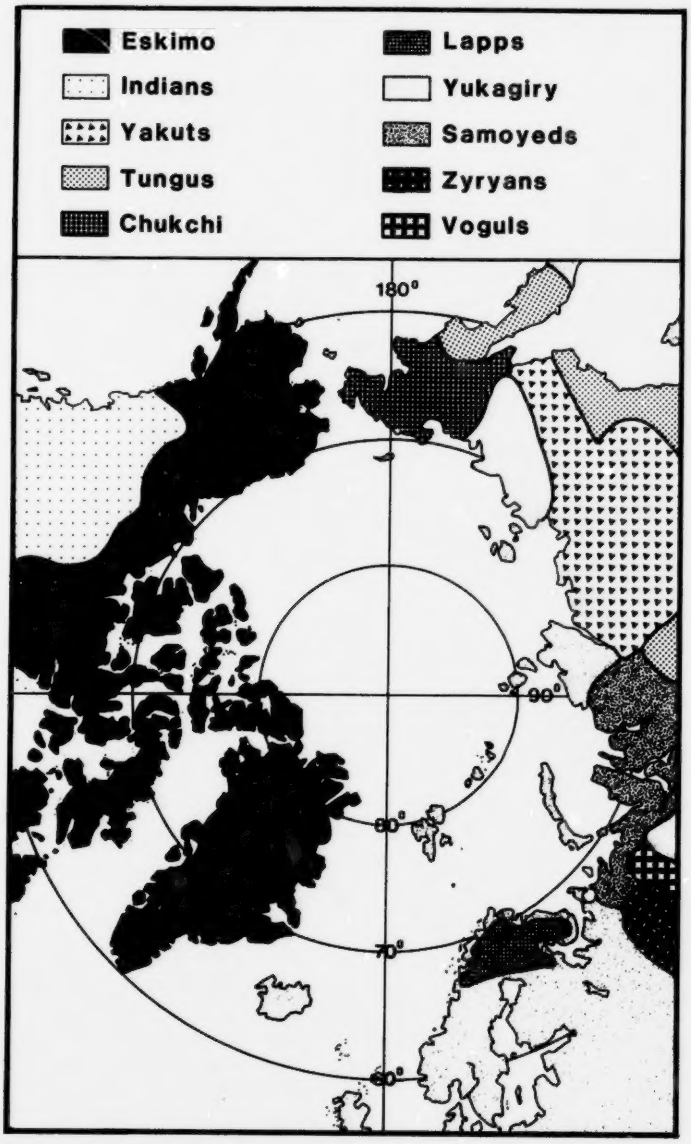


Figure 1 Spatial distribution of circum-arctic peoples.
Source: Louis Rey (1982).

the creation of large wildlife preserves (Hunt, 1976). In general, hunting in these areas was limited to the native people, with the intent of protecting the wildlife upon which their livelihood and culture depended. But in 1966 these preserves were virtually eliminated with the approval of the territorial and federal Governments.

Today, in Canada and other arctic countries, general conservation regulations do exist, for example for hunting. Some arctic lands have also recently been reserved for national parks or other protected areas (Nelson, 1976; Scace, 1976). The effectiveness of these conservation efforts is, however, questionable. Yet the Arctic may now be subject to greater stress that at any time before in its history (Usher, 1982). Sources of stress include accelerating exploration for development of petroleum deposits and other minerals, growing native populations and concomitant exploitation of wildlife, increased military activities, and potentially significant climatic variations resulting from increasing CO_2 and other man-induced as well as natural changes.

Fortunately, concern about the development and conservation of the Arctic has been accelerating in Canada, Norway, and other circumpolar countries, for the last several years. Three principal forces appear to be behind this resurgence of interest. The first is arctic petroleum development. The second and third are the 1982 Law of the Sea Convention (Johnson and Zacher, 1977; United Nations, 1982a, 1982b) and the 1980 World Conservation Strategy (WCS), respectively (IUCN/WWF, 1980).

Arctic Petroleum Development

The United States, Canada, and Norway, have been involved in arctic coastal and offshore petroleum development for many years. For example, the US now has a producing offshore field in the Prudhoe Bay area off the Alaskan north slope. Canada has discovered deposits of oil and gas in the Beaufort Sea and the Sverdrup Basin, but not yet in commercial quantities or circumstances (Brooks, 1983). Norway has recently extended offshore exploration beyond 62^0 N and three promising areas are currently being explored along the north coast (Lind, 1984).

While anticipating important benefits from oil and other mineral discoveries, many people have been concerned about the possibly adverse effects of blowouts, oil-spills, and similar misadventures on the marine mammals, fishes, and other resources, upon which sustainable development by indigenous people largely rests (Keith and Wright, 1978). Environmental Impact Assessments (EIA) and other measures have been introduced to assist in identifying, planning for, and managing, such unwanted effects, notably in the US and Canada (Rees, 1979; Couch, 1982). EIA legislation is under active consideration in Norway, and soon will be applied to arctic offshore activity in that country (Lind, 1984).

Very recently in the US and Canada, the results of EIA or comparable reviews have opened the way for increased development off the Alaskan north slope and the Mackenzie Delta, Canada. The US Department of the Interior plans to offer for sale oil-leases for about 8.4 million acres (3.4 million hectares) in the Diapir Field, from three to one-hundred-and-eighty miles (*ca* 5 to 288 kilometres) off the north coast of Alaska (Shabecoff, 1984). In Canada, an EIA panel has stated that small-scale oil and gas development is now environmentally and socially feasible within the Beaufort Sea, given careful planning and management safeguards (Federal Environmental Assessment Review Office, 1984). In summary, in several arctic countries the stage has been reached for a major oil-development thrust well off-shore.

The Law of the Sea Convention

After more than decade of effort, the Law of the Sea Convention was agreed to by representatives of more than one hundred nations in 1982 (Borgese, 1983). The convention is not, however, legally in force until formally approved by those nations. The US, Japan, and several other countries, did not sign the first text and have indicated that they will not endorse the convention–in part because of perceived difficulties in sharing advanced offshore mining technology with less-developed nations.

A major feature of the 1982 Law of the Sea Convention is its provision for declaring an Exclusive Economic Zone (EEZ) which extends scientific environmental protection, resource management, and other national responsibilities, for two hundred miles (320 kilometres) beyond the coast (Theutenberg, 1984). As a result of current declaration of EEZs, the arctic "map" is already substantially different from that of the former "open seas" system prevailing until 1981 (Figure 2). Declarations aside, the final fixing of EEZ boundaries is controversial among countries and will take years to solve. Extensive offshore areas and many fishing, mining and other opportunities, are at stake–to say noting of military and geopolitical considerations. The implications of the EEZs and the new political arrangements for arctic waters, are a major source of international interest and are acknowledged to be worthy of careful study–especially as they relate to agreements, conventions, and institutional cooperation, for international resource-use and conservation.

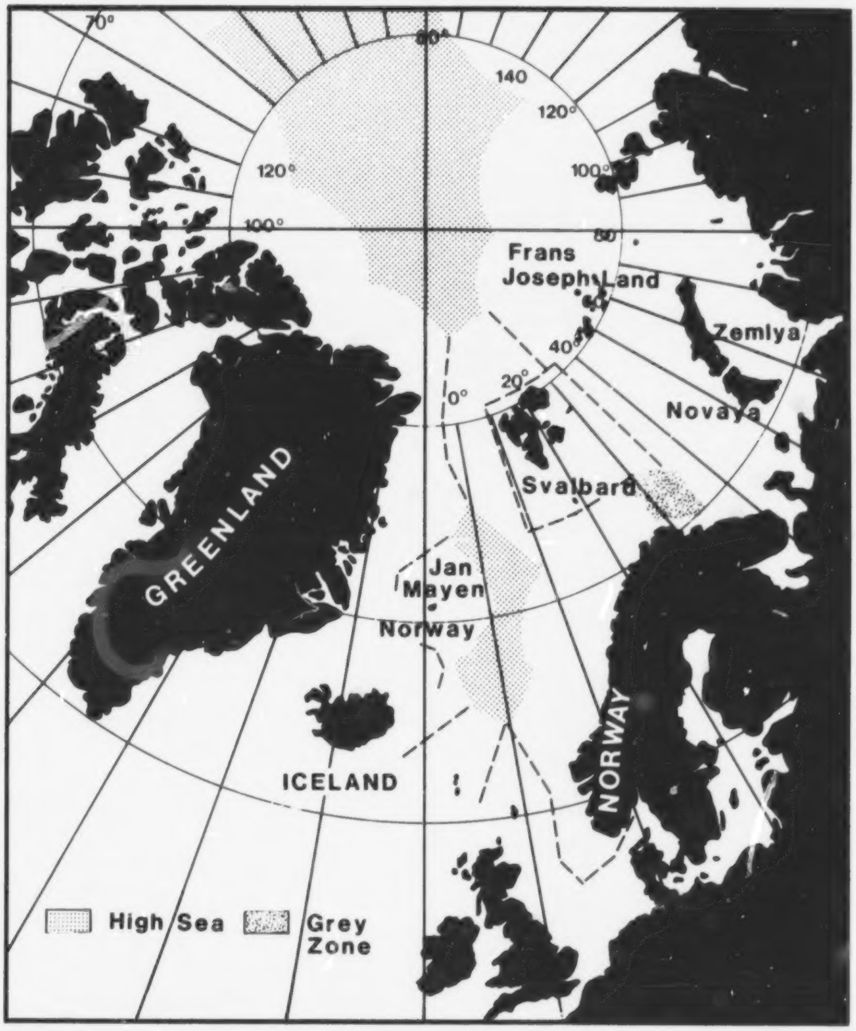


Figure 2

The result of the Law of the Sea with regard to the Arctic. Only small parts of the high seas remain after coastal states, such as Iceland, Norway, Great Britain, and Canada, have established their 200 nautical miles' exclusive economic zones.

The World Conservation Strategy (WCS)

The development of the WCS by the International Union for Conservation of Nature (IUCN) in cooperation with the United Nations Environment Programme (UNEP) and the World Wildlife Fund (WWF), and in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO), arose from growing concern about a multitude of escalating global resource and environmental problems which threatened the human capacity for sustainable development on Earth. Examples of problems include over-harvesting of fish and other animals, oil and other marine pollution, drainage and other reclamation projects which often destroy useful resources, deposition of toxic or other chemicals from coastal industrial operations, and growth of population beyond the sustainable level particularly when based in large part on renewable use.

Those problems are found plentifully in the Arctic, although their extent and seriousness are not well understood. It is also increasingly questionable whether benefits from petroleum and other "mega-projects" will provide significantly greater well-being for much-increased numbers of northern people, at least in Canada. Petroleum exploration and development has, however, been more successful in this regard in Alaska and central and southern Norway than in Canada, though whether such benefits will be realized also in northern Norway remains to be seen.

As a basis for sustainable development and living-resource conservation, the WCS sets forth three main objectives: (a) to maintain essential ecological processes and life-support systems such as migratory routes for whales; (b) to preserve genetic diversity, for example the Muskoxen and Polar Bear (*Thalarctos maritimus*); and (c) to ensure the sustainable utilization of species and ecosystems, for example in northern Norway and to the east where hydroelectric projects and offshore petroleum development are threatening the resources upon which many Lapps or Samoyeds live.

The WCS attempts to meet the foregoing three objectives through a process which involves, among other things: proposing national and subnational strategies; recommending anticipatory environmental policies; proposing integrated land-and water-management methods, supplemented by EIAs; proposing more management-oriented research than at present; recommending increased public participation; and promoting more international action than currently exists to coordinate and support national programs.

International cooperation is especially important in the Arctic because caribou, Reindeer (*Rangifer tarandus*), and other herds, migrate freely across political boundaries, as do whales and other marine mammals and fishes. Oil-spills and other forms of pollution do not respect national boundaries either. A further point of importance is the presence of indigenous peoples with strong ethnic links in Alaska, Canada, and other polar countries (Bankes, 1983: Jull and Bankes, 1984). Hence the interest in forming transnational associations such as the Inuit Circumpolar Conference or ICC, which joins the Inuit (Eskimos) of Alaska, Canada, and Greenland (Jull, 1979; Canadian Arctic Resources Committee, 1981). The interest of local people in securing increased benefits from, and greater control over, their own destiny, has attracted considerable support from members of industry, university, and governmental and other organizations, in the US, Canada, Norway, and elsewhere (Hodgins *et al.*, 1977; Dacks, 1981).

Need for More Cooperative, Comprehensive International Planning and Management

It appears clear from the foregoing that accelerating development and environmental problems in the Arctic, while very much national concerns, may also transcend national boundaries and often require international cooperation for solution. Indeed, the knowledgeable participation of local, regional, national, and international, groups is necessary if the issues are to be planned and managed in a sensitive and workable way. Such an approach is implicit if not explicit in initiatives such as the WCS. The WCS supports the development of regional strategies to advance the use and conservation of shared living resources, notably with respect to international rivers and seas. Indeed, IUCN and other agencies have identified priority seas where cooperative and more comprehensive approaches are seen as essential for any properly sustainable development (IUCN/UNEP/WWF, 1980 Section 19).

The Arctic Ocean is one such sea, for which a planning conference is recommended in the WCS, but none has yet been held. Similar conferences in other parts of the world have led to the acceptance of UNEP Regional Seas Programme as a means of effectively balancing development and conservation (Bliss-Guest and Keckes, 1982).

The UNEP Regional Seas Programmes

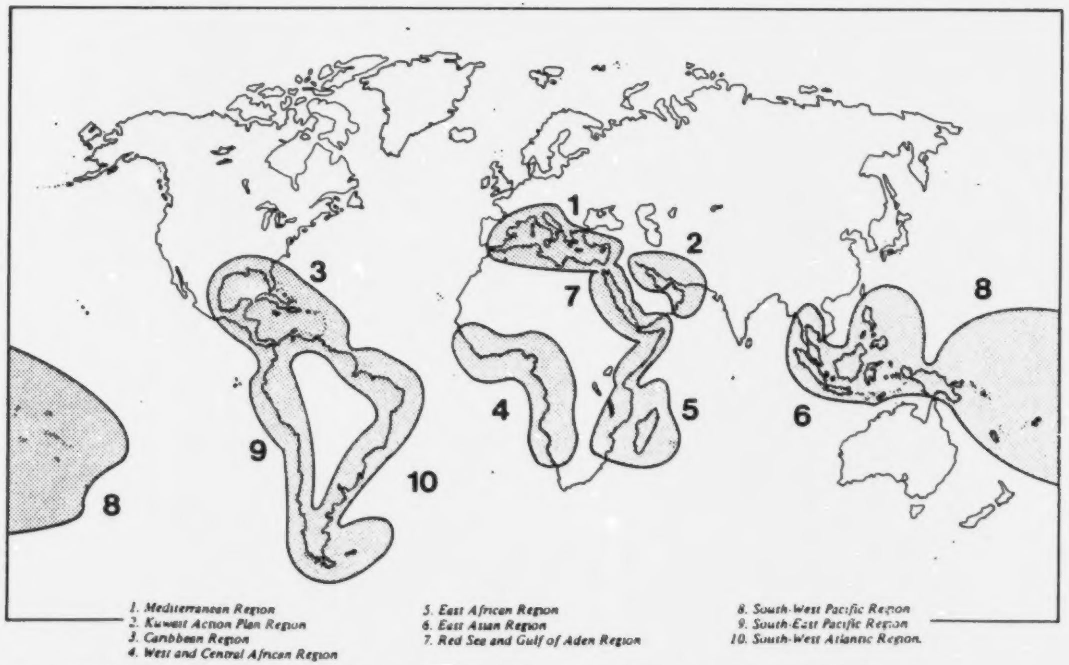
Although relatively little may be known about the concept in some countries, the United Nations Environment Programme (UNEP) Regional Seas Programme has been under way since 1974. It stems from the 1971 UN Conference on the Human Environment (Stockholm) and the idea that environmental assessment and management, and supporting measures such as research and education, can provide the basis for action plans and ultimately for a better balance than currently exists between development and conservation–especially if undertaken from a predominantly regional standpoint (Thacher, 1983).

Currently, the Regional Seas Programme includes eleven regions involving more than 120 coastal states (Figure 3* and Table 1). In eight of these regions, action plans have been approved and in six of them regional conventions supporting the action plans have been adopted (UNEP, 1982). The adoption of the eleventh regional action plan and the signing of two additional regional conventions are envisaged by the end of 1985. UNEP, the organization which was established *inter alia* to carry the Stockholm thrust into the future, reportedly has been able to lead the Regional Seas Programme through an action-oriented four-parts' strategy including the following basic elements (Thacher, 1983):

> Promotion of international and regional conventions, guidelines, and activities, for the control of marine pollution and the protection and management of aquatic resources;
>
> Assessment of the state of marine pollution, of the sources and trends of this pollution, and of the impact of the pollution on human health, ecosystems, and activities;
>
> Coordination of the efforts with regard to the environmental aspects of the protection, development and management, of marine and coastal resources; and
>
> Support for education and training efforts to make possible the full participation of developing countries in the protection, development, and management, of marine and coastal resources.

Although decidedly regional in character, the units of the Regional Seas were chosen and delimited through careful consultations and planning at the international level. UNEP, in association with IUCN, WHO, FAO, and other agencies, has generally undertaken the background studies to identify issues, arrange for the preparation of scientific papers, and identify knowledge-gaps, research needs, and implications of current policies. This documentation is presented to government leaders, notably at workshops aimed at obtaining agreement on a Convention around which further cooperative action by the nations of the region concerned can be organized.

In general, this process seems to have worked well, although an organized action plan and an agreed-upon convention may not prove to be necessary in all regions in order to secure cooperation in research, planning, and management (Thacher and Meith, 1980, 1982; Meith and Helmer, 1983; Thacher, 1983). Concern about the growing level of pollution of coastal waters and of its effect on tourism, fisheries, and coastal development, as well as realization of the transboundary nature of this pollution, have served to make pollution a very vital issue or concept upon which to


1
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1. Mediterranean Region
2. Kuwait Action Plan Region
3. Caribbean Region
4. West and Central African Region
5. East African Region
6. East Asian Region
7. Red Sea and Gulf of Aden Region
8. South-West Pacific Region
9. South-East Pacific Region
10. South-West Atlantic Region.

Figure 3 Spatial distribution of the ten (earlier) UNEP Regional Seas Programmes. Source: Bliss-Guest and Keckes (1982). (A referee points out that "Figure 3 should include also the South Asian Seas region (covering Pakistan, India, Bangladesh, Sri Lanka, and the Maldives) falling geographically between regions 2 (Kuwait Action Plan Region) and 6 (East Asian Region)." Ed.)

build the initial coalition. Concern then frequently seems to spread to over-fishing, natural hazards, population growth, and infrastructural and other issues.

A major benefit of most if not all of the programs is the research and exchange of information which is generated, thereby creating greatly improved understanding of regional problems and needs. Of much importance in facilitating cooperation is the technical and financial help provided by UNEP to convene early meetings, bring experts and politicians together, and assist in the organization of research and the interpretation and dissemination of its results. It is evident from the published reports on Regional Seas in various parts of the world that availability of such funding is becoming a problem even as the number, size and complexity, of Regional Seas Programmes increase. A crucial question is whether the nations of the various regional seas will be sufficiently convinced of the resulting benefits to begin assuming a major share of the costs themselves.

Table 1 Participants in UNEP Regional Seas Programme and Related Regional Conventions. *Source: Thacher (1983).

Participants	*Regional Signed*	*Convention Ratified*	*Participants*	*Regional Signed*	*Convention Ratified*	*Participants*	*Regional Signed*	*Convention Ratified*
Mediterranean Region			*Kuwait Action Plan Region*			*Caribbean Region*		
Albania	...	...	Bahrain	Yes	Yes	Antigua-Barbuda		
Algeria	Yes	Yes	Iran	Yes	Yes	Bahamas		
Cyprus	Yes	Yes	Iraq	Yes	Yes	Barbados		
Egypt	Yes	Yes	Kuwait	Yes	Yes	Belize		
France	Yes	Yes	Oman	Yes	Yes	Columbia		
Greece	Yes	Yes	Qatar	Yes	Yes	Costa Rica		
Israel	Yes	Yes	Saudi Arabia	Yes	Yes	Cuba		
Italy	Yes	Yes	U. Arab Emirates	Yes	Yes	Dominica		
Lebanon	Yes	Yes				Dominican Rep.	Regional convention in preparation	
Libya	Yes	Yes				France		
Malta	Yes	Yes				Grenada		
Monaco	Yes	Yes				Guatemala		
Morocco	Yes	Yes				Guyana		
Spain	Yes	Yes				Haiti		
Syria	Yes	Yes				Honduras		
Tunisia	Yes	Yes				Jamaica		
Turkey	Yes	Yes				Mexico		
Yugoslavia	Yes	Yes				Netherlands		
EEC	Yes	Yes				Neth. Antilles		
						Nicaragua		
						Panama		
						St Lucia		
						St Vincent		
						Suriname		
						Trinidad and Tobago		
						U.K.		
						U.S.A.		
						Venezuela		

Table 1 (continued)

Participants	Regional Signed	Convention Ratified
West and Central African Region		
Angola	...	...
Benin	Yes	...
Cameroon	...	...
Cape Verde	...	...
Congo	Yes	...
Eq. Guinea	...	...
Gabon	Yes	...
Gambia	Yes	...
Ghana	Yes	...
Guinea	Yes	...
Guinea-Bissau	...	...
Ivory Coast	Yes	...
Liberia	Yes	...
Mauritania	Yes	...
Namibia	...	...
Nigeria	Yes	...
São Tomé and Principe	...	...
Senegal	Yes	...
Sierra Leone	...	...
Togo	Yes	...
Zaire	...	...

Participants	Regional Signed	Convention Ratified
East African Region		
Comoros	Action plan preparation initiated	
Kenya		
Madagascar		
Mauritius		
Mozambique		
Seychelles		
Somalia		
Tanzania		
East Asian Region		
Indonesia	No regional convention included in action plan	
Malaysia		
Philippines		
Singapore		
Thailand		
Red Sea and Gulf of Aden Region		
Democratic Yemen	Yes	...
Djibouti	...	...
Jordan	Yes	...
Palestine (PLO)	Yes	...
Saudi Arabia	Yes	...
Somalia	Yes	...
Sudan	Yes	...
Yemen	Yes	...

Participants	Regional Signed	Convention Ratified
South-West Pacific Region		
Amer. Samoa	No regional convention included in draft action plan	
Cook Is.		
Fiji		
Fr. Polynesia		
Guam		
Kiribati		
Nauru		
New Caledonia		
Niue		
Norfolk Is.		
Papua New Guinea		
Pitcairn Is.		
Solomon Is.		
Tokelau		
Tonga		
Pacific Is. Trust Terr.:		
N. Marian Is.		
Marshall Is.		
Micronesia		
Palau		
Tuvalu		
Vanuatu		
Wallis and Futuna		
Western Samoa		

Participants	Regional Signed	Convention Ratified
South-East Pacific Region		
Colombia	Yes	...
Chile	Yes	...
Ecuador	Yes	...
Panama	Yes	...
Peru	Yes	...

Participants	Regional Signed	Convention Ratified
South-West Atlantic Region		
Argentina	Action plan preparation initiated	
Brazil		
Uruguay		

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* A referee writes that this table: '... should also include the South Asian Seas Region with an indication of "Action plan preparation initiated". The Caribbean and the Red Sea conventions have been adopted and opened for signature. The latest status of regional conventions should be updated.' – Ed.

The Mediterranean Program

To provide further understanding on the nature of the Regional Seas Programme, a more detailed review of the Mediterranean programme will now be undertaken. This program is selected for such consideration because it is the oldest and apparently best-documented, relatively economical to study, and concerns an area that is familiar to the Authors. The Mediterranean includes some countries with economies and societies that are similar to those bordering the Arctic Ocean, our prime area of interest (Anonymous, 1978a, 1978b, 1980, 1982; Thacher, 1983).

Following the UN Stockholm conference, and after extensive preparatory work by several UN bodies, UNEP convened the Intergovernmental Meeting of the Protection of the Mediterranean, in Barcelona, Spain, from 28 January to 4 February 1975. February 1976 (Anonymous, 1978a). (See the account by Stanley P. Johnson on pp.235-6 of our 1975 volume.–Ed.) (See the special account by Peter S. Thacher on pp. 152-3 of the Summer issue of our 1976 volume.–Ed.) Representatives of sixteen nations attended and, after detailed deliberations, approved an Action Plan consisting of four components: (|) legal (framework convention and related protocols); (2) scientific (research and monitoring); (3) integrated planning, and (4) institutional and financial arrangements. On the basis of guidelines developed through intergovernmental consultations since 1973, a working text of a framework convention with two protocols was presented to the delegates and, following their directions, was revised by legal experts for a subsequent meeting.

At the request of Mediterranean governments, UNEP then convened a Conference of Plenipotentiaries of the Coastal States of the Mediterranean Region on the Protection of the Mediterranean Sea, again in Barcelona, during 2-16 February 1976 (Anonymous, 1978a). This meeting adopted a Convention for the Protection of the Mediterranean Sea against Pollution and also Protocols on the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft and on Cooperation in Combating Pollution of Mediterranean Sea by Oil and Other Harmful Substances in Cases of Emergency. A proposal was also tabled to establish the Regional Oil-combatting Centre (ROCC) for the Mediterranean. The above adoptions followed the deliberations of the two main conference committees, various task-oriented sub-committees, and of the meeting itself, and were subsequently opened for signature by approving nations. Clearly the perception and preparatory work of the international agencies concerned had succeeded in identifying issues which propelled the regional Seas Programme in the Mediterranean.

Early actions following the 1976 Barcelona meeting led to the strengthening of research projects and programs which had been developed prior to the two Barcelona meetings. A pilot research phase was begun, with seven projects to be carried out over a two year period through technical meetings and seven networks of cooperating national or other research centres (FAO/UNESCO and others, 1983). The seven projects dealt mainly with coastal matters, although studies of pollution in the open waters of the Mediterranean were subsequently introduced. UNEP and associated international bodies collaborated in leading and assisting with the research, which has primarily been executed through activities of existing national institutions. As of 1978, sixty-three research centres in fourteen Mediterranean countries had been identified as active participants in the Regional Seas process (Anonymous, 1978b). Support has been provided to some in such forms as equipment, funds, and training. Attempts have been made to link the research to management issues that had been identified in discussions and meetings of representatives of member states. An example is a study of Pollutants from Land-Based Sources in the Mediterranean area (UNEP/ECE and others, 1984). This was requested by Governments and has contributed to the formulation of the technical aspects of a Protocol intended to control the land-based pollution problem. This Protocol for the Protection of the Mediterranean Sea against Pollution from Land-based Sources was adopted by the Mediterranean Governments in May 1981. Programme. (A referee writes that "The sub-regional centres of ROCC which were once proposed were never established."–Ed.)

The results of what has become a five-years' pilot study–MED POL, or the pollution monitoring and research program–were reviewed by government experts in January 1981 when a long-term program was drawn up (Thacher, 1983; UNEP, 1983), and today more than 90 Mediterranean research centres participate in it. Reference methods for marine pollution studies, and environmental quality criteria for recreational waters, shellfish-growing areas, and seafood, have been drafted. The ROCC established in Malta, with projected sub-regional centres in other parts of the Mediterranean area, was reviewed by government experts in 1980 and found to be of continuing usefulness. Another interest arising from the Mediterranean Regional Seas Programme is in creating a large network of specially-protected marine areas. Governments agreed on the text of an enabling Protocol, which was adopted and signed on 3 April 1982 (Thacher, 1983 p.455).

All Mediterranean countries (except Albania), and the European Economic Community (EEC), are associated with the Mediterranean Action Plan as well as with the Barcelona Convention and its protocols (UNEP, 1982, 1983). As a result, much research has been generated and information exchanged, though less information seems to be available on the progress or effectiveness of management and supporting components. In this regard, evaluative studies are needed on the implementation of the

Regional Seas Programme in the Mediterranean and in other parts of the world. How effective has it been in terms of criteria such as improved water-quality, reductions in wetland drainage, better-designed coastal tourist developments, more parks and protected areas, and the like?

Applicability to the Arctic

Nevertheless, enough evidence seems to be available to consider seriously the application of the concept to the Arctic. Some of the legal and policy foundations for a program are already present. Various conventions, agreements, and institutional arrangements for international cooperation in conservation, have been in place for years (Armstrong *et al.*, 1978). Examples include the 1918 Migratory Bird Treaty which binds Mexico, the US, and Canada, and could be useful in EuraAsia and Africa (Canada, 1917), the 1946 International Whaling Convention (Tonnessen and Johnsen, 1982), and the 1975 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). These agreements, however have wide applicability outside the Arctic, and this might affect their usefulness as a basis for discussion of greater cooperation among arctic nations. The 1976 Agreement on the Conservation of Polar Bears might be more helpful in this regard, as would consideration of institutions established to promote improved interaction–for example, the Northern Science Network created among the arctic countries under the 1971 UNESCO Man and the Biosphere (MAB) Programme.

Other related or bilateral or multilateral research on oceanographic, atmospheric, and biophysical, matters has been conducted, but on an *ad hoc* basis, by such nations as Canada, Denmark, Norway, Sweden, United Kingdom, United States, and the USSR. Examples include Alpha Ridge (CESAR), the Fram Strait Project (FRAM), and Marginal Ice-zone Experiment Project (MIZEX) (Commission for Scientific Research in Greenland, 1982, 1983). However, no overall framework currently exists within which to conceptualize, plan, implement, monitor, and reformulate, efforts at cooperative research for conservation and sustainable development. Nothing in the arctic context systematically links mutually-agreed-upon goals, objectives, and policies, to a legal base–or to research or environmental assessment, planning and management mechanisms, and supporting financial, educational, or other programs.

Canada has an opportunity to lead in the examination of the Regional Seas concept as a means of providing such a framework for more effective cooperative and comprehensive arctic planning and management. In the next two years, at least three relevant workshops or conferences are likely to be organized. The first, led by Canada's Department of Environment (DOE), is intended to evaluate conventions, agreements, and institutional arrangements, for conservation in the Arctic under the general title of "International Cooperation for Conservation in the Circumpolar North". It has been recommended that seven current conventions, agreements, or institutional arrangements, be examined on this occasion. The seven are: the 1918 International Migratory Bird Treaty; the 1946 International Whaling Convention; the 1975 Convention on International Trade in Endangered Species of Wild Fauna and Flora; the 1976 Agreement on the Conservation of Polar Bears; the 1982 Law of the Sea Convention; the 1971 UNESCO Man and the Biosphere Programme, and the 1974 Regional Seas Programme. Another topic for a possible agreement is "Environmental Impact Assessment". The Regional Seas Programme offers one likely institutional framework for tying such conventions and agreements together in a mutually supportive way.

Another relevant proposed meeting is the Arctic Heritage Symposium which is being organized by the Association of the Canadian Universities for Northern Studies (ACUNS) in cooperation with the Commission on Ecology and the Commission on National Parks and Protected Areas of IUCN. The Symposium involves a "state-of-the-art" examination of atmospheric, marine, geomorphic, biological, and other basic components of arctic ecobiomes and ecosystems, with some assessment of current human impacts through pollution and other sources. It also involves an examination of land-use and conservation, focusing on a review of the role of national parks and protected areas in different arctic countries. The intent is to identify current knowledge-gaps as well as research, planning and management, needs at regional, national, and international levels. An Arctic Regional Seas Programme could provide a framework into which this Symposium and its results could be set.

The two foregoing meetings are relatively small in scale and can only begin the process which might lead to an Arctic Regional Seas Programme. A third which might help in the same way is a conservation of lands conference that is being considered by Canada's Department of Indian and Northern Affairs (IAND). Such meetings can be very useful in bringing scientists, environmental planners and managers, and governmental and nongovernmental organizations, together to examine the needs and possible approaches to them. A further likely forum for widely constructive discussion would be the World Conservation Strategy meeting to be held in Canada in 1986. The goals and objectives of the WCS are often said to be laudable, but its operation is said to be "soft" in the sense that the means to implement it are vague. The example of the Regional Seas Programme may, however, well suggest otherwise. A full evaluation of its progress and actual achievements in different parts of the world would be very useful, and should be available before the DOE Workshop and the ACUNS Symposium begin in the autumn of 1985. (See the "Important Prospect" on page 90 of this issue.–Ed.)

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Summary

Although many people still view the Arctic as little affected by human activity, the region has been the home of Man for thousands of years and its wildlife and ecology have been changed in many ways in the last four hundred years as a result particularly of the commercial and technical activities of western industrial nations. Three forces are, however, now bringing more and more attention to the use and conservation of arctic lands and seas: (1) arctic petroleum exploration and development, which is becoming increasingly extensive offshore in Alaska, Canada, and Norway; (2) The Law of the Sea Convention, which is leading to the division of the formerly open Arctic into large spheres of national jurisdiction through the declaration of Exclusive Economic Zones (EEZ); and (3) the World Conservation Strategy, which is providing the conceptual basis for the international cooperation and comprehensive management that is clearly needed to introduce sustainable development in the Arctic.

It is suggested that one promising means of planning and implementing balanced use and conservation in the waters and adjacent lands of the Arctic is through the UNEP Regional Seas Programme. This institutional arrangement is already being used in similar resource-management circumstances in eleven other regions of the world. The Regional Seas Programme is action-oriented and includes four basic elements: (1) promotion of international and regional conventions, guidelines, and activities; (2) assessment of marine pollution and related effects; (3) coordination in protection, development, and management; and (4) support through training, education, and other means.

A brief illustrative review of the Mediterranean Regional Seas Programme indicates that it has worked well in the identification of concerns, in promoting integrated management-related research, and in various other ways. However, far more information than is currently available on the actual effects on water quality, park and protected area establishment, and other criteria, would be helpful in assessing strengths and weaknesses

of the UNEP Regional Seas Programme in the Mediterranean and other parts of the world.

Nevertheless, enough information is already available to suggest that the Regional Seas Programme could provide the institutional framework which is needed to facilitate the international research, planning, and management, that will be prerequisite to sustainable development in the arctic realm. Several forthcoming conferences which are being planned in Canada could provide fora for the discussion of a Regional Seas Programme or comparable arrangement in the Arctic.

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Response to Report of Task Force on Northern Conservation[1]

J.G. Nelson for ACUNS

The Association of Canadian Universities for Northern Studies (ACUNS) welcomes the publication of this report which addresses the significant question of how to provide for more effective conservation in the North, where this term refers to the Yukon and Northwest Territories. The report and the work of the Task Force arise from public and government concern about long term management of northern resources, a concern that is shared by many members of Canadian universities and the Canadian research community.

In this response we wish to focus on the research and advanced educational aspects of the Report, in keeping with ACUNS' role in regard to the North. In so doing we will focus on those recommendations which particularly could benefit from more research and analysis prior to implementation as well as those recommendations which directly address research and educational concerns.

The Importance of Integrating Development and Conservation

Beginning with the last point, as the report indicates, conservation of wildlife, plants, archaeological sites, and other natural and cultural resources is vital to economic and cultural well-being in the North. Continuance and enhancement of hunting, fishing, recreation, water supply, and other economic and cultural activities depend upon sound management of resources and environment. The issue is one of balancing or integrating development and conservation - of sustainable development - particularly for northerners with a commitment to long term residence in the North. In this context the report is a very important one, meriting the prompt and careful attention of governments, especially the new federal government. Here we are very mindful of the recent federal government budget cuts which will reduce the already limited capacity to undertake research upon and manage northern resources.

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[1] This paper was submitted to the Minister of Indian and Northern Affairs by ACUNS in response to a request for comments on the Northern Conservation Task Force Report.

The Need for Prompt Action on the Report

In this regard it is unfortunate that the Task Force makes little specific reference as to how the report should be handled after submission - beyond urging widespread public discussion. Given the lack of any suggested framework or schedule for discussion and advice to the Minister of Indian Affairs and Northern Development and the Ministers of Renewable Resources, Northwest Territories and Yukon Territory, there is a good chance the report will disappear from public view without effective follow-up. We recommend that the three Ministers establish a formal hearing and discussion process for the Report, with a deadline for review and submission of recommendations by say, November 1, 1985. If such a process were established ACUNS would be prepared to submit a fuller response.

Environmentally Significant Areas as a Fundamental Step in Comprehensive Resource Management

The Task Force quite rightly links integrated resource management with protected area management. By integrated resource management is meant incorporation of conservation policies and practices into hunting, fishing, mining, lumbering, and other sectoral activities on a co-ordinated basis, for example through regional planning. Activities would not be treated separately but rather related to one another and to the desires and well-being of people at the local as well as the national level. In using the term, "protected areas," the Task Force is referring to National Parks, Canada Wildlife Areas, Territorial Parks, and other means of managing caribou calving areas, waterfowl nesting sites, important aquifers, historic sites and other environmentally significant areas or ESAs.

We are of the view that the report does not establish well enough the fundamental importance of identifying, describing, and providing for protected area or other appropriate management of environmentally significant areas, or ESAs, as the fundamental basis for integrated or comprehensive land use planning. Without the proper identification, description, and management of nesting sites, aquifers, or other areas which are significant to hunting, fishing, water supply, or other uses in large surrounding regions, sustainable development is difficult if not impossible to achieve. From this perspective it is the identification and description of the calving, nesting, productive wetland, or other areas that is the important first step. National parks, territorial parks, and other types of protected areas are not the only way of managing such areas. Zoning under Area Development Ordinance, territorial land use regulations, or other institutional arrangements is also appropriate in certain cases. Further study is desirable on how legislation, policy, and institutional arrangements might be linked more effectively with the characteristics, objectives, and needs of ESA.

Clarifying the Role of the conservation or Heritage Advisory Board

One means of undertaking follow-up studies like those referred to above is promptly to appoint the Conservation Advisory Board recommended in the report. Before doing so, however, some clarification of the nature and role of the Board would be beneficial. As outlined in the Report, the Board apparently would be primarily concerned with the establishment of protected areas, although in both the short or interim, as well as the longer term, the Board would assist in the implementation of the comprehensive land use systems now being introduced into the territories. Any distinction between the role of the Conservation Advisory Board and the Planning Commissions and other bodies being considered as part of the new comprehensive northern land use planning process is not clear. In this regard, it may be better to create not a Conservation Advisory Board but a Heritage Board, with a charge to work specifically with important wildlife, plant, scenic, historic, or other ESA and the national park, territorial park, zoning, or other means of using and conserving these areas for hunting, education, research, tourist, or other purposes. We also see such a Board as having an important role to play in the promotion and support of studies and research noted as desirable in the Report.

Comments on Recommended Institutional Arrangements

Other attractive recommendations in regard to institutional arrangements include establishment of a cabinet committee made up of federal ministers with northern natural resources responsibilities to ensure a common federal response to conservation issues, consolidation of all territorial land and other natural resources responsibilities within one territorial department to ensure a common territorial response to conservation issues, acceptance and implementation by the Department of Fisheries and Oceans of its legitimate responsibility as lead agency for Arctic Marine Conservation, and development of federal-territorial agreements for transfer or devolution of federal resource administration and management responsibilities to the territories.

Reasoning for these changes is, however, not always clearly set out in the Report, notably in regard to the advantages and disadvantages of a single resources department at the territorial level. Ways of linking territorial government agencies, any new Conservation (or Heritage) Advisory Board, the proposed new Land Use Commissions, and any related federal departments is not clearly spelled out in the Report. The achievement of a workable system for co-ordinated comprehensive management may take many years. In this respect prompt clarification of the Conservation Advisory Board role, in order to provide for more rapid progress in regard to identification, description, and management of ESAs - the basis of comprehensive land use management - seems very desirable.

Support for More Coastal and Marine Conservation and for Related Research

We are strongly in support of the recommendations for more attention to conservation, including the establishment of coastal and marine protected areas in the North and concur with the suggestion that much more needs to be known about the natural qualities, use and appropriate management of such areas. We support the recommendation that the Department of Fisheries and Oceans take a stronger leadership role in regard to marine conservation and urge that more rapid progress be made with federal and territorial departments on such related initiatives as the Parks Canada Marine Parks policy. As a result of many uncertainties about how park and other management concepts may work on the coasts and in the oceans, we believe that an experimental approach is desirable, with careful monitoring of results and a willingness and ability to adjust as required. In this regard we support studies of experience in other areas, for example, the federal and state park system in Alaska or the Coastal Zone Management programme there. The latter provides for national, territorial, and local co-operation in development, conservation, and management of environmentally significant areas along the Alaska and other U.S. coasts.

Support for Improved Information and Communication on Northern Conservation

We support the recommendations on improvement of information and communications systems in regard to conservation. The proposed Conservation Advisory Board and other government agencies can assist here, but university faculty and students can also do more appropriate research and writing, with support from SSHRC, the Canadian Studies programme and other sources. We intend to so indicate to our membership. ACUNS has also begun to work more closely with the NWT Science Institute and other territorial agencies on such matters.

Support for Protected Areas for Environmental Monitoring and Research

We would like to underscore the importance of northern parks, wildlife refuges, and other protected areas as sites for research or monitoring of the state of the environment, with special reference to "acid rain" and other longer term atmospheric changes of major long term significance to mankind. Federal and territorial parks and other protected areas can serve as valuable long term environmental bench-marks. In this regard we are very supportive of the recommendations that legislation should be enacted to provide for the joint establishment and management by the federal and territorial governments of a system of ecological areas, i.e. a system to provide for the better management of areas of importance for wildlife, plant, ecosystem, or other unique or representative purposes. Such a system can be especially valuable for research and monitoring and as a basis for gaining greater overall understanding of past, present, and future resource and environmental conditions in the North.

Better Means of Describing and Analyzing Significance and Potential Forms of Management of or ESAs

Finally, more study is required as to the best means of identifying, describing, and providing for the management of environmentally significant or heritage areas. The issue of identifying and describing an area in terms that justify its designation as some type of park or protected area has been a central one in regard to northern conservation for many years as has the associated question of how to decide upon the appropriate type of park, wildlife, or other management status for lands with special biophysical, hydrologic, scenic, historic, or other qualities. The lack of a consistent, systematic, and generally acceptable means of making these two decisions has been a fundamental reason for the failure to create many park or other protected areas in the North in the last decade.

The fact that hundreds of areas had been proposed for protected area status by IBP, federal and territorial parks, Canadian Wildlife Service, and other groups, but few confirmed as such, led to a March 1983 Whitehorse Workshop which recommended that a Task Force on Northern Conservation be set up to find ways of breaking the "logjam." Central to this task is finding a way to describe candidate areas in terms that identify a range of convincing reasons for special management. These reasons should be based on scientific or other concepts that are generally acceptable to the groups competing for use and control of candidate areas. These competing parties include federal and territorial departments as well as corporate and other private interests. These groups often cannot agree on whether an area has characteristics which merit special management because information is incomplete or because the characteristics are not described in terms that make it possible to establish natural or cultural significance in a consistently convincing way. Nor have means been available for analyzing the strengths and weaknesses of laws, agencies, and other institutional arrangements and linking them with the characteristics of areas having significant natural or cultural qualities. Even with such means of describing areas and analyzing legislation, and potential forms of management, there will of course still be a need for value judgements in deciding on whether an area merits special management, for what reasons, and what form that management should take.

All the foregoing issues are addressed, notably in Appendix A of the Task Force Report, but in an incomplete manner, with a focus on general questions and a method that is unlikely to provide the kind of information needed to satisfy contending parties and lead to a breaking of the "logjam." The nub of the problem can be seen by quoting a key statement in the Report:

> It is evident from the selection criteria recommended in this Report, as well as in the heritage rivers report, that there is an obligation for specialists to present the case that a candidate area is either unique or representative, or that it contains outstanding rare, or endangered species. In many cases to present such a case, specialists will need to base their professional assessments on variables such as diversity, productivity, or vulnerability. The Task Force respects this approach at the scientific level, but cannot recommend the use of such evaluation criteria for the day-to-day decision of land-use planning.

The ramifications of this statement are profound indeed. It implies that no attempt will be made to reach general agreement on the range of variables that will be used to describe candidate areas - and many criteria have been used, including some with less scientific validity or sustainability that others. The quote also implies that no attempt will be made to reach agreement on the technical definition of variables such as rarity, uniqueness, and diversity - and such definitions can vary considerably. It also implies that such criteria should not be used in dealing with citizens, businessmen, politicians, and others who will be involved in assessing the descriptions of candidate areas and in making decisions about them.

Such a statement implies a gulf between the technical or professional and the lay or interested person that is incompatible with the consistent working of a broad public consultation process like that advocated so strongly in a number of places in the Report. As much familiarity with technical or scientific considerations as possible seemingly is desirable, and should be the basis for the making of the associated value judgements that are part of decision-making.

In sum then, careful study and consideration of identification, description, and analysis of appropriate management arrangements for candidate areas is still very much an issue which should be addresssed at an early stage by a Conservation Advisory Board or other bodies oriented to implement the major thrusts of this very important and timely Report.